AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

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Vertical and Horizontal Boring Machines.

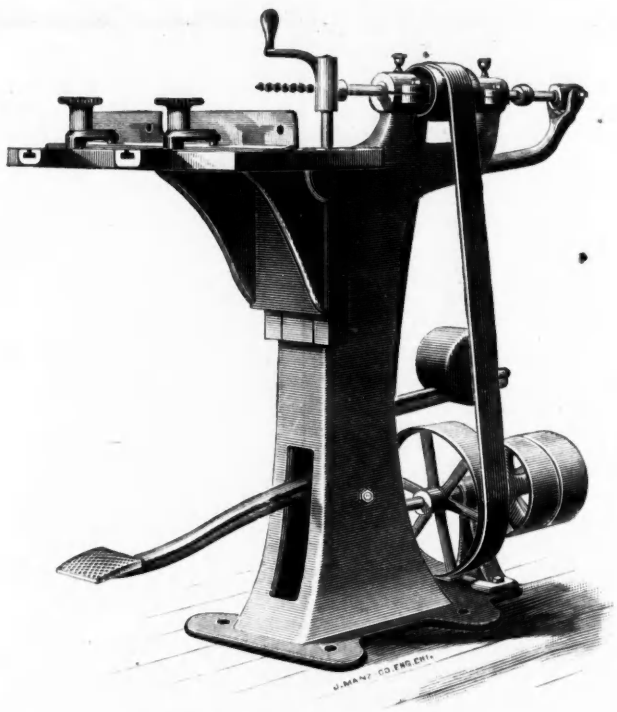
The single spindle vertical universal machine is designed to meet a demand for a machine having more capacity and larger range than is usually found in single spindle machines. The column is substantial and of neat construction; the machine is strong and durable in every part, and is self-contained and ready to operate without any attachment but to the floor.

The table is gibbed to planed ways cast on the column, and is raised and lowered by a screw. The actuating hand-wheel is under the table, within easy reach of the operator. The table has a movement on the column of twelve inches, and an angular adjustment of 40°, and the fence is adjusted by sliding the holding bolts in the slots made in the face of the table. When in operation the table is fixed in its position.

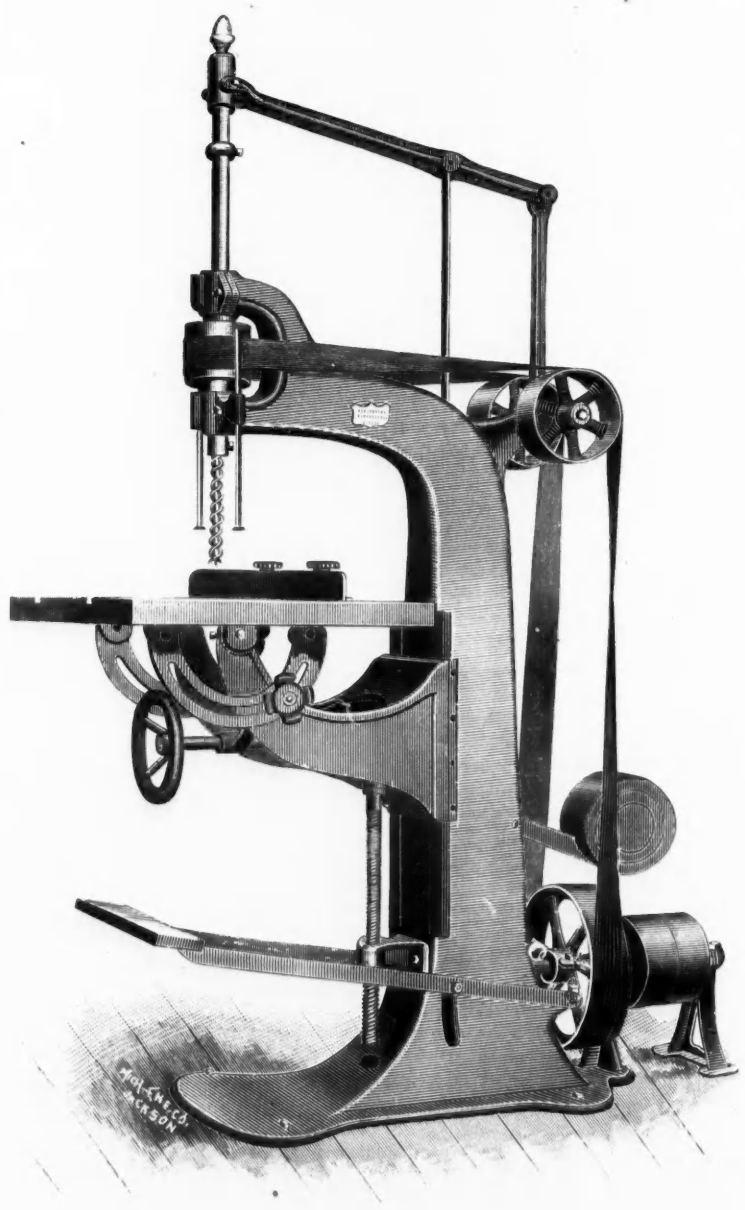
The boring spindle is brought down to the work by a treadle operated by the foot of operator, and is returned from the work by a counter-weighted lever connected at the top. It is provided with vertical stops for holding down the work when the bit is being drawn out. The spindle is $1\frac{1}{4}$ inches in diameter, has a movement of 12 inches, and is 18 inches from the column, allowing the boring of a hole in the center of 36 inches; it is also at right angles with the countershaft, and receives the belt over idler pulleys, which are perfectly adjusted.

The machine has sufficient power to run a two-inch bit in hard wood, and is easy to operate. The tight and loose pulleys are 10 inches x 4 inches, and should make 500 revolutions.

The horizontal machine is of new design. The column is cast in one piece; the table is gibbed to the column, and raises to accommodate any thickness of stuff up to six inches, by a single screw. The guide on the table is adjustable to any angle on the plane of the arbor. The bit is brought forward to the work by means of a treadle, and returned by a counter-weight. The boring arbor has a travel of eight inches. The machine is very substantial. Tight and loose pulleys on counter are 8 × 3, and should make 800 revolutions. These machines are made by E. Dennis & Co., Jackson, Mich.



HORIZONTAL BORING MACHINE



VERTICAL BORING MACHINE.

Some of our exchanges are calling attention to the alleged fact that instantaneous photography has definitely settled the question as to whether or not the upper part of the wheel of a vehicle moves faster than that part which is on the ground. We hardly think instantaneous photography was really needed to settle this question, and had supposed it was pretty well settled long ago.

It is one of those questions which is so very simple as to make its practical demonstration unnecessary.

The world's production of gold for 1886 is given as $97,961,000. But is the world actually that much better off than if this gold had not been produced at all? There are some pretty strong arguments going to show that a single acre of ground planted in cabbages is of more actual value to the world than all its gold, aside from that which is used in the manufacture of articles of utility.

Electric Motors.

There is, no doubt, plenty of room for small electric motors; plenty of places where they may be used to excellent advantage, and where other means of driving would be impracticable. But the introduction of electric motors is very likely to be delayed by over-statements of their efficiency as compared with that of the steam engine driving direct. In a recent article in a daily paper, evidently prepared by someone who knew nothing of the subject, and with the unconcealed intention of "booming" electric motors, the friction between the steam engine and the work to be done by it is put at eighty-five to ninety per cent. of the power of the engine, eighty-five being the minimum. Now, anyone at all acquainted with such matters knows that a loss of eighty-five per cent. in the power developed by a steam engine in getting that power to the work to be done, not only represents very extreme conditions, but generally poor engineering. And when this argument is advanced to prove that it is better to use fifty electric motors in a building, driven from a central station perhaps two miles away, because the loss of power will be less than with an engine in the building, the verdict is likely to be that those who use this argument are dishonest or ignorant. There is no way to discredit any mechanical arrangement more effectively than to make gross misstatements about something that competes with it. The electric motor should be introduced on its merits, then it is likely to succeed.

The assumption that every patent issued for something that does not prove financially successful represents sheer waste of money and effort is erroneous. In many instances a mechanic does his first persistent mechanical thinking in the direction of something that he patents, and though he may get no return in dollars and cents for his efforts, the start he gets in the direction of using his brains to some purpose may pay the cost many times over. While our advice would be not to spend money in patenting things that will not bring a money return, we still believe that the work of doing this is often valuable in an educational sense, and if a man does make the mistake of paying for a patent for his ideas that will not sell, he has often got a good return for his money. To do the inventing and then stop short of paying for the patent, would, of course, be better.

It should be noticed with satisfaction that the technical press is very generally hammering away at the subject of boiler explosions, showing that in nearly every instance they might have been prevented by reasonable care. Constant dropping wears the stone; constant hammering will eventually tell in the way of waking up boiler owners to a sense of their responsibilities.

The railroad systems of the United States are of immense advantage in the way of developing the country. This is no argument why they should be allowed to dominate things with which they have no connection, but it is an argument against senseless abuse of them.

Condition and Prospects of the Machinery Business.

LETTERS FROM PROMINENT ESTABLISHMENTS TO THE "AMERICAN MACHINIST."

The Waterhouse Electric and Manufacturing Company (Arc and Incandescent Lighting Apparatus), Hartford, Conn., write us:

A well-lighted factory increases production, and the electric light is in demand.

The success of the Waterhouse system of arc and incandescent lighting is remarkable. It has competed succes-fully with the best systems, and the following factory and mill plants are among those installed:

Weybossett Mills, Providence, R. I; Whitin Machine Company, Whitinsville, Mass.; Slater Cotton Company and E. Jenckes Manufacturing Company, Pawtucket, R. I.; Forest Fiber Company, Berlin Falls, N. H.; Billings & Spencer Company, Hartford, Conn.; Jarecki Manufacturing Company, Erie, Pa.; Church & Co., Brooklyn, N. Y.; E. R. Carhuff, Newark, N. J.; Cobbs, Mitchell & Co., Cadillac, Mich.; Oval Wood Dish Company, Mancelona, Mich.; R. & H. Simons Silk Mills, Union Hill, N. J.; Warder, Bushnell & Glessner, Springfield, Ohio.

We are having such a demand for our apparatus that we have doubled our capacity. While we are furnishing all size plants, we are also making dynamos for four arc lights and up, which will interest the small shops, and these plants are now running and giving satisfaction Our regulator is applied to the dynamo in a very simple way, and has such control that the safety of the apparatus is assured. The cost to operate an arc light of our system is much less than two cents per hour per light.

The Laidlaw & Dunn Company (Pumps, Tobacco Machinery, Pipe and Fittings), Cincinnati, Ohio, write us:

We are pleased to state that our business has been very good during the year, and has increased right along toward the end of it, and our prospects for next year are indeed very flattering. We have increased our tools twice during this last year, very largely, and are now putting in some heavy tools for large work in hand. There has been no change, of late, in the price of labor, but raw material is gradually increasing in price, which is always a great benefit to trade.

Brehmer Bros. (Engineers and Machinists), Philadelphia, Pa., write us:

We can say that the past year was exceedingly good with us; we have been overrun with orders. We would also say that, on account of the impending dissolution of partnership heretofore existing between Hugo Brehmer and Hugo Bilgram, the business will be conducted, after the first of January, by Hugo Bilgram in his name.

Darling, Brown & Sharpe (Machinists' Tools), Providence, R. I., write us:

Our business during the past year has shown a considerable increase over that of 1886. But few new tools have been added to our lists, as the demand for those already advertised has kept us fully occupied. The demand for accurate tools is constantly increasing, and it is our intention always to be prepared to meet it.

The American Twist Drill Company (Mechanics' Tools and Knitting Machines), Laconia, N. H., write us:

Our business has been good during the year, and prospects for 1888 look very encouraging. We shall add new tools to increase facilities for the prompt filling of orders.

The Joseph Dixon Crucible Co. (Crucibles, Graphite Paints, Pencils and Lubricants), Jersey City, write us:

We have had a greater volume of business in all our lines during the year 1887 than in any previous year. The profits of the business, however, will not be so large as in some previous years of smaller sales, owing to cut prices on almost everything. During the year 1887 we have enlarged our works by one brick building, 25x100, three stories. We have added one new steam boiler to our steam plant, and have changed our steam heating system so that we heat our buildings with exhaust steam.

For 1888 we dare not predict. The message of President Cleveland, advising a serious reduction in the tariff as against the abolition of burdensome internal revenue taxes and his insinuation of dishonesty on the part of manufacturers, who struggle to get fair profits on their goods, throws a dark shadow over the future, and how it will come out, no one at this date is able to predict.

The Pratt & Whitney Co. (Machinists' Tools), Hartford, Conn., write us:

The number of employes of the Pratt & Whitney Co. increased during 1887 from five hundred to seven hundred, and the latter are now at work on full time. During the year one hundred and fifty Gardner machine guns were made and shipped to the Italian Government, and work begun on Hotchkiss ordnance, for U. S. navy. The aggregate value of shipments was $850,000. A four-story and basement storehouse of brick with stone trimmings, begun in September, has been nearly finished, and will give nearly as much floor surface as the main factory, for patterns and finished machinery.

The Hill Automatic Grain Weigher business has gained surely, and our confidence that the apparatus is reliable obtains with all who try it. Prices for labor have changed very little for twelve months, but lathes, drills, screw machines, combination lathe chucks, machine screws and pipe taps are now selling at greater discount from list than at any time past.

Hill, Clarke & Co. (Machinery), Boston, Mass., write us:

Our business for the year '87 has been very satisfactory, and we think in volume about 50 per cent. more than last year.

We do not think that machine shops are enlarging to any great extent, simply adding what machinery is absolutely necessary.

We have a very large lot of unfilled orders on our books, and some which will not be filled for six or eight months yet, owing to the great amount of work in the shops.

Prices have not changed materially, being about the same as at the first of the year.

P. Blaisdell & Co. (Drill Presses), Worcester, Mass., write us:

Our business is very good indeed, much better than last year at this time; are having a large number of inquiries, and are making sales about as fast as we can make the machinery. Have increased our force and put in new machinery during the past year. The outlook for the coming year is good.

Wages are higher than last year; stock is also higher. Prices for machinists' tools rule very low.

The Universal Radial Drill Co. (Universal and Radial Drilling Machinery), Cincinnati, Ohio, write us:

We have had a satisfactory year's business, having produced more machines (and we believe better ones) than during any previous year, and at no time in the past year have we been even with our orders.

We are now settled in new quarters, with greatly increased plant and facilities, and can readily care for larger business.

We have experienced no trouble with labor nor have rates of wages changed; cost of material practically same as a year ago.

The Cleveland Twist Drill Co. (Drills, Reamers, etc.), Cleveland, Ohio, write us:

We have run our factory full time and full handed the whole year; something we have not done before for several years. We have added considerably to our plant during the year and are building additional machinery now. Have sold off some of our old machines to make room for those of new design now building. Prices have remained firm, and we have had all we could possibly do to fill orders promptly. Collections are just a little slow in the Western States, but elsewhere are good. We have had very few bad accounts, and are congratulating ourselves on having had a good year, and on the prospects of one to come.

Pedrick & Ayer (Special Tools for Railway Repair Shops), Philadelphia, Pa., write us:

Our business during the past year has been very prosperous. We have added to our plant one 14", one 16" and one 20" lathe, one shaper, one heavy universal milling machine, one steam hammer, one combined drilling and boring machine, and new machine tools for our pattern shop. We have a full force of skilled mechanics employed; these have been increased by ten men over last year. We have added to our list of specialties a heavy universal milling machine, with patented attachments; a cylinder boring and facing machine; an apparatus for heating, setting and removing tires; a patent portable key-seating machine; an adjustable shrinkage gauge; a patent boiler scale cutter, and several other smaller specialties. Our general business of repairing engines, reboring cylinders in place, has been and is very brisk. We have about all we can properly attend to during the holidays. We have purchased a lot of ground with two fronts, 40 feet each, on Hamilton and Buttonwood streets, with a depth of 160 feet. This lot is half a square below us, and it is our intention to erect thereon a shop suitable to our business, equipped and fitted out with the latest improvements that can be obtained for all requirements in our line of trade. Judging from our inquiry book, business for 1888 will be very good indeed.

The Wainwright Manufacturing Company (Corrugated Tubes, Feed Water Heaters, etc.), Boston, Mass., write us:

The year '87 has been most encouraging to us, and '88 promises very favorably. On October 26th ult. we reorganized our company under very favorable circumstances. We have recently been obliged to enlarge our works and have added a number of first-class tools, and will increase our force to 100 men at an early date, with the probability that a further increase will be necessary during the coming year. Our books show an increase over '86, in sales of heaters, of 40 per cent., and a corresponding gain in output of corrugated tubing, expansion joints, radiators, etc. We have a large list of orders ahead, among them being a number for heaters and expansion joints for large and important steam plants. We note an increasing demand for our manufactures abroad, and have no fault to find with the outlook.

E. P. Bullard (Bridgeport Machine Tool Works), New York, writes us:

In regard to the results of the past year, we can state that we are very well pleased.

We moved in April last from our old store at 14 Dey street, where we had been for eleven years, to the present one, 72 Warren street and 62 College place. Notwithstanding this necessary interruption to our business, we have sold more machinery in the past year than we have since the boom, and if we were getting the same rate of prices we received then, we think the amount of our sales would be beyond our best year.

Our new store being larger and better adapted to our business, enables us to carry a larger line of stock for immediate deliveries.

Our Brown & Sharpe Manufacturing Co. agency, we being exclusive selling agents for them in this section, has been very satisfactory. We carry a line of samples of their machines in stock.

Our Bridgeport machine tool works, located at Bridgeport, Conn., has been kept busy with an average of 115 employes. Mr. Bullard now resides at Bridgeport, and gives this his special attention, the result of which has been a larger output than ever before.

We have added some to our plant, both in regular tools and special fixtures, etc., for the cheapening of cost of production. We have developed and brought out several new tools, for which we have had ready sale.

We trust that the business of the next year will be as satisfactory, and hope that Congress will not meddle with the tariff, and thus prevent it.

William Tod & Co. (Founders, Machinists and Engine Builders), Youngstown, Ohio, write us:

Our business the past year has taxed our capacity to its utmost, principally on our Porter-Hamilton engines and Hamilton blowing engines.

For the past two months there has been a little falling off in orders, but at present we have a very brisk inquiry, and we believe there is little doubt of full shops the coming year.

We have made no very marked enlargement of our facilities at any one time, but are constantly adding tools and appliances of various kinds.

Have expended about $15,000 in this way during the past year and a half.

The P. H. & F. M. Roots Co. (Rotary Blowers), Connersville, Ind., write us:

The volume of business done by us during the last year has been very satisfactory; indeed, it has been satisfactory enough to prompt us to improve and add to our works to such an extent that our capacity has been doubled. The improvements consist of an entirely new foundry with every modern improvement, new offices and drafting rooms, and a very large addition to our machine shops, and from $5,000 to $10,000 worth of new and improved machinery. Our facilities for turning off work will be doubled and far better than ever before. We have been behind with orders all the year, having had a strong demand for blowers and a specially good trade with our new style gas exhauster. We now have orders on our books that will keep us busy until spring, but with our increased facilities we will be able to take care of all orders that require prompt shipment.

The Brown & Sharpe Manufacturing Co. (Machinery and Tools), Providence, R. I., write us:

Our sales show a considerable increase over 1886. The works have run ten hours per day throughout the year, and 55 machine tools have been added. On the first of January 621 hands were employed, and there are at this writing 732. The increased production has been in several lines, notably in "Universal Milling Machines," which for the past two years we have made with special tools and in lots of 100 at a time, thereby securing great perfection at a moderate cost, and enabling us to sell them at prices to defy competition when the quality of work and number of attachments are considered. During this year we have erected another fireproof brick building four stories high, which contains over one acre of floor space. This will be used as may be required by the increase of any branch of our business. The number of inquiries and orders received during the past two months seems to indicate a prosperous business for the coming year.

Nicholson & Waterman (Machinery and Tools), Providence, R. I., write us:

It is difficult to formulate any statement. During the past nine months we have placed upon the market a new lathe designed and built to wear for generations, under the ordinary every-day usage which such a tool must receive, without having either its accuracy or scope affected.

We have commenced the manufacture of a line of bolt and nut machinery which thus far gives us much encouragement for the future. The first two machines for milling and for turning bolts you have already made special mention of and we are now building our first lot, all of which are sold. The unusual accuracy with which work can be done, and at a reduction in cost, makes this machinery especially attractive.

We are also building, under contracts, trucks and fittings for electric street trucks to be used in Woonsocket, R. I., Allegheny City, Penn., and Fulton street, New York.

As a whole, the outlook for the coming year is very encouraging.

The Newark Machine Tool Works, East Newark, N. J., write us:

We are very well satisfied with the results of our efforts during the past year. We have sold large lathes, slotters pulley machines, horizontal, drilling and boring machines, and various special tools. In work of this class trade must be fairly conquered by those who start under a new name; but, since last May we have secured a most gratifying lot of orders, and as all our work has given the most complete satisfaction, we have no fear for a good year in '88. We have a good supply of work for next year on our books.

The New Haven Manufacturing Co. (Machinists' Tools), New Haven, Conn., write us:

Our business for the year now closing has been quite satisfactory. We have had plenty of work, and at present find no lack of orders, and, so far as we can see, the outlook is favorable.

The Hoggson & Pettis Manufacturing Co. (Lathe Chucks, Dies, Stamps, etc.), New Haven, Conn., write us:

Our business during the year '87 has been quite satisfactory, our books showing considerable increase over that of last year, and especially in our chuck department.

We are adding steadily to our working force, and with the space devoted to the manufacture of our type-writer, and the contracts for special machines we have on hand, which will occupy considerable room, our once commodious factory will be pretty well filled, and the outlook for 1888 is very bright.

Wages remain as usual, while the cost of material has advanced somewhat.

The Mason Regulator Company, Boston Mass., write us:

A comparison of the business done by us in 1887 with that of 1886 would be hardly a criterion, since last year we put upon the market a reducing valve which immediately exceeded in sales our expectations. The business in other goods exceeds, this year, that of 1886 by a small percentage. Taken as a whole, our business will show an increase of 100 per cent. or more—due almost entirely to the adoption, by some of the leading railroads and car-heating companies, of a reducing valve de-igned especially for this purpose. On the latter article it will probably take us at least two months to fill the orders which we now have on hand, to say nothing of some large orders promised us by railroads. As to new machinery, we

ordered some recently, but others seem as busy as ourselves, and it is not yet delivered. We shall probably order some more before long. Our prices remain the same, although if the copper boom continues we may be obliged to raise them.

D. Frisbie & Co. (Elevators, Clutches, Engines, etc.), New York, write us:

Our business has been very uniform for the past year; have been comfortably busy most of the time; for past two months have been very busy on large orders for clutch pulleys for electric light plants. We have had to run full force fourteen hours a day to get out contract by January first. We are putting in the shafting and clutch pulleys for the Utica Electric Light Company, Utica, N. Y., engineered by Geo. H. Reynolds, 44 Wall street, and is one of the best layouts we have been connected with. We have done about 25 per cent. more business this year than last, and the outlook is good for the future.

Schleicher, Schumm & Co. (Engineers and Builders of the "Otto" Gas Engine), Philadelphia, Pa., write us:

We enjoyed a marked increase of business during the year, especially for the larger engines. We are now offering the "Otto" up to 40 horse-power, and supply gas companies with power for electric lighting of such industrial establishments as use our gas. We have contract on hand for combination of engines and pumps for sewage service in El Paso, Texas, and expect a decided increase in our sales to gas companies and municipalities in the near future. The demand for smaller engines continues as brisk as heretofore.

The Stearns Manufacturing Co. (Saw Mill Machinery, Engines and Boilers), Erie, Penn., write us:

We have to report, during the past year, a very busy season. We are sorry to say, however, that the prices do not appear to improve with the volume of business presented. Customers, however, who are willing to pay for an extra class of work are more numerous, and the outlook for business next year is certainly as favorable as it was a twelvemonth ago. We have, this season, purchased about six acres of ground, and purpose, within the next six months, to remove our entire establishment to a location assuring greater convenience in the matter of shipping facilities. We have already erected and occupied our boiler shop, 80 × 200 feet, which, so far, we consider a model of its kind, having 17 feet rolls, two 72 inch riveters, overhead cranes and stock bins, together with the advantage of railway tracks entering the building. Our smith shop, 50 × 147 feet, is already under roof. The foundations for the main machine shop, 80 × 300 feet, two stories high, are completed, and the foundry, 60 × 200, well under way. It is needless to say that the designs of these shops embody all of the improved facilities for handling work that we have been able to gather from experience, observation, and the use of your valuable columns. There are no changes, to speak of, in the rates of labor in this community, although piece work, accompanied by careful inspection, is making some headway among us. In the matter of boilers, steel may be said to have entirely supplanted iron. We note, also, an increased demand for the use of cast-steel in many parts of our productions, more especially in those machines where the motive power is manual labor—the object being to lighten the parts, and, at the same time, increase the strength, and there is no doubt that, were the price brought down to a more reasonable figure, it would be used to a very much greater extent in the hard worked saw mill machinery. We trust that our next annual report of progress will be from our new machine shop, where we will be glad to see you and all others of our esteemed friends.

Cooke & Co. (Machinery and Supplies), New York, write us:

We are pleased to report, as a result of the year's work, a large increase in the volume of business over preceding years, but regret that we cannot make an equally satisfactory report in the matter of prices, which have been very close. One of our troubles, this year, has been to get goods to fill our orders. On some of our specialties—especially the stub ends for connecting rods, which we sell to engine builders all over the country—we have been very much behind our orders. Taking it altogether, we consider that the past year's business has been a very healthy one, and that the prospects are good.

The S. Ashton Hand Manufacturing Co. (Machinery and Tools), Toughkenamon, Pa., write us:

We have little to report in regard to business or the prospects for the coming year.

Nearly the entire year has been spent in redesigning our 14-inch engine lathes, and in devising and making special tools with which to manufacture them.

While we have made some stock during the year, we have not got any advertising matter out, nor attempted to market any of the new product. When we get ready to open the ball you will probably hear something drop.

Warner & Swasey (Machine Tools and Special Machinery), Cleveland, Ohio, write us:

The volume of our business for 1887 has been much larger than any previous year, and has necessitated the addition of new machinery, which enables us to keep a force fully 25 per cent. larger than we employed one year ago.

The great demand for our brass-working tools has led us to improve our methods of manufacture, so that we are now making some of them in lots of 50 at a time and with the parts interchangeable to a large degree. We have increased our list of brass-working tools by adding two sizes of "Universal Monitors," and also two sizes of "Forming Lathes" for shaping irregular forms such as gauge cocks, air cocks, bib handles, etc.

The outlook for the new year seems very bright, and we think there is reason to expect a continued and increasing prosperity for our country. The AMERICAN MACHINIST still holds its place with our workmen, and we enclose a list of thirty subscribers for 1888.

The Harrison Safety Boiler Works, Germantown Junction, Philadelphia, Penna., write us:

Our business has been increasing steadily for some years. Last year we increased our plant, doubled our capacity, and cannot yet keep ahead of orders. We have made some radical changes in the construction of our steam generator, and we believe the Wharton-Harrison form of boiler the best we have ever made, containing all the best features of the old form and some new ones of decided value.

Besides our large mill trade, our steam generators are being highly appreciated for all steam heating, the efficient heating surface, combined with the safety element, making them particularly desirable for the purpose

Neither raw materials nor labor have varied much in price, nor have selling prices made any marked gain, but business has been steady and rushing, and we suppose small profits must be expected in these days of great competition.

Our business in Cochrane Feed Water Heater and Purifier, which was comparatively new when mentioned a year ago, has been good, and the heaters are giving satisfaction in many cases.

The Kensington Engine Works, Limited (Engineers and Machinists), Philadelphia, Pa., write us:

During the year just closing we have been more than busy, even with our increased facilities. The total sales will exceed by one-third those of 1886, which we felt was a good year for us.

We have declined a number of orders because we could not meet the prices tendered by others without lowering the standard of work we have been doing. Our engine sales have increased, and what has been very gratifying is that many of our orders were from those who have had the Buckeye in use and tested its many advantages.

Our feed water heater department has been materially extended to meet the demands for the Kensington heater, which we are furnishing in three types: return tubular, straight-through tubular and horizontal tubular.

While orders have fallen off in the last sixty days, yet we have more than sufficient to keep us fully occupied, with a fair prospect ahead.

Williams, White & Co. (Forming and Forging Machines, etc.), Moline, Ill., write us:

We have had a very good year's business. We might have done more if the shops had been larger, and are now full of orders, and more offering than we can get out promptly. The outlook is for a full year's business, and still we must confess that we can see that much work has come indirectly through the railway construction of the past year, and if that ceases as it now seems to bid fair to do, the demand for work will be greatly lessened. But there is no letting up yet, that we can see. We are seriously thinking of building another shop the coming spring, and would do so if we were sure that trade would keep up, but we have seen the mischief of too great expansion in more than one case, and feel rather conservative.

Especially has the demand for our forming and forging machine, "The Bulldozer," and also for the line of forging machines that we manufacture—drop presses, hammers, etc.—been active.

The Buckeye Engine Co., Salem, Ohio, write us:

Naturally we are glad to be able to say to you that the year now drawing to a close has been a remarkably successful one with this company. The demand for Buckeye engines of all kinds and for a great variety of purposes has been steady throughout the year, and taxed our capacity to the utmost to supply. Our whole force has been employed ten hours each working day, and so much overtime in addition as they were physically capable of enduring, so that we have made more engines and greater aggregate horse-power than in any previous year of our history.

We have to note a slight advance in wages during the year, but with improved methods it does not appear that our engines cost us any more than previously, nor have we been able to get any better prices than heretofore.

We see no reason why our business for the coming year may not be as good as the past, since inquiries by mail are as numerous and promising for the future as they were a year ago.

The disturbing influence of a congressional session, which promises a revision of the tariff in the direction of free trade, is a factor in the question of the future outlook for business that cannot be estimated, and is always to be deplored.

We think that, with this exception, prospects for business in general are very flattering.

The Skinner Engine Co. (Engines and Boilers), Erie, Pa., write us:

Our business for this year has been considerably larger than for '86: necessitating our purchasing additional machinery to handle same.

We look for an even better business next year if the tariff is not disturbed.

Several letters stand over, to appear in our next issue.

Steam Engine Governors.

In discussing Mr. Ball's paper on An Improved Form of Shaft Governor, read at the Philadelphia meeting of Mechanical Engineers, W. C. Kerr brought out some pertinent points in regard to steam engine regulation. Mr. Kerr said:

The question brought up by Mr. Denton is in the line of what I intended to say. He asks why ordinary governors cannot be made to give the regulation desired, and why these various supposed perfect forms do not give the regulation which they ought.

I think the principal reason has scarcely been mentioned in this discussion. It is friction. About one-half of all bad regulation is due to governor friction Everyone in the engine business knows that weights, springs and lever arms can be so proportioned that when the governor is in a proper state of lubrication, it regulates in a thoroughly satisfactory manner, and the same governor, when not properly oiled, gives poor regulation; also, that no changing of leverages, springs, etc., or the addition of extra parts, will bring a poorly lubricated governor into condition for satisfactory regulation.

Some forms of governors have their friction greatly diminished by excellent constructive features, and others by superior lubrication. I do not know what governor Professor Thurston referred to in his paper, as I was not present, but it is probably Professor Sweet's, as he made some experiments with the straight line engine. I happen to know something of the action of this governor, having worked on it in its earliest days, when friction was excessive, and when various plans were experimented with to improve it. They all failed, but when the friction was taken out of it by the excellent construction now used, it needed no dashpots, supplemental springs or other contrivances.

The most important question to ask in connection with governors is, what kind of regulation do we want? and the answer is, first, a reasonably small variation in speed, whether the engine is light or loaded, said variation being measured in revolutions per minute. This variation can be made small or large, at the discretion of the manufacturer, and one or two per cent. variation is considered sufficiently close on engines used for ordinary manufactories. Second, a very small acceleration for an instant following a change of load, and where the most delicate regulation is required, this instantaneous acceleration is of much greater consequence than the difference in revolutions between light and loaded.

In work requiring very delicate regulation, the injury is done during the period of this acceleration, and the period is the time between the change of load and the starting of the governor to move, and is proportional to the friction. It is therefore plainly evident that devices which are added to the governor, which act only after the governor has started to move, cannot in any way affect the acceleration of the engine during the period above mentioned. We therefore cannot look to auxiliary devices as a means of preventing the most serious consequences of bad regulation, and while they may be ingenious and mathematically correct, their operation is too late to obviate the difficulties which they are designed to remove.

Further than this, the addition of various devices usually increases the friction, and thereby may become even harmful where very close regulation is desired. Under such circumstances it is quite possible for a governor regulating within two per cent. to have its regulation reduced to one per cent., when the regulation is measured in revolutions per minute, and at the same time the acceleration of said governor is found to be many per cent. greater than before the auxiliary devices were applied, and in such delicate adjustment of speed as is necessary for incandescent lighting, it is possible to thus produce a very injurious action on the lamps.

I believe that if more attention were paid to exactly what good regulation consists of, there would be less attention paid to devising appliances whose operation must be subsequent to the starting of the governor, and more attention paid to relieving the governor of the resistances which tend to prevent its starting from rest.

The Benevolent Society of the F. and P. M. Railroad Shops.

We have received from Herman W. Grobe, treasurer of the Benevolent Society of the F. and P. M. Shops, at East Saginaw, Mich., an account of the working of that society, which may be of general interest. In explanation of the rules, a copy of which Mr. Grobe sends us, it may be said that the society is managed by a committee of six, one from each department of the works. The manager in each department collects 50 cents per month from each member in his department, and turns it over to the secretary of the society. He also receives applications for membership, and visits those that are sick. Each member pays 50 cents per month, although provision is made for assessing the members, should it be necessary. Rule XVII is as follows: "Members on sick list shall receive $5 per week for thirteen weeks, $3 per week for the next thirteen weeks, and $2 per week for the next twenty-six weeks."

Rule XVIII is: "Funeral benefits shall be paid as follows: Upon the death of a member, $30; a member's wife, $20; a member's child, $10, when the child is under fourteeen years and over three days old."

In this society provision is made for dividing the surplus funds amongst the members each year. So far it has been found that there was quite a sum to be divided. Thus, in 1884 the dividend to each member was such as to make the actual cost to him only 75 cents. This year it is not expected that the dividend will be more than about $1.50. If there were no dividend it seems a small sum for the possible benefits to be received, and for the pleasure of helping others.

Modern Locomotive Construction.

By J. G. A. Meyer.

FIFTY-FIFTH PAPER.

Proportions of Driving Axle Boxes.—In designing a locomotive driving box we must not lose sight of the fact that all the weight which is placed upon it must be supported by the upper part of the axle journal. Indeed, herein lies a great difference between a locomotive driving box and an ordinary pillow block similar to those used in many stationary engines. In the former the pressure is against the upper part of the box, and consequently the oil which is fed through the oil holes in the top of the box will be aided to flow away from the elements of contact. In the ordinary pillow block the pressure is against its lower part, and if the pressure is not sufficiently intense to force out the unguent from between the surfaces, the oil will be aided to some extent to flow towards the elements of contact.

It must also be remembered that the vertical pressure on a locomotive axle journal is almost constant, which in nowise will assist in the lubrication of the journal. In pillow blocks of stationary engines, although the pressure is generally towards the bottom of the block, it will shift a little from one side of the pillow block to the other as the piston changes the direction of its motion, and thereby assist in the lubrication of the journal.

These considerations lead us to conclude that locomotive axle journals are more liable to become hot than the main journals of stationary engines. To prevent as much as possible hot axle journals, we must proportion them in a manner which will allow upon them a comparatively low pressure per square inch. The pressure on any journal is estimated by the pressure per square inch on its projected area. By the projected area of a journal is meant the area of a rectangle whose length and breadth are respectively equal to the length and diameter of the journal. For further explanation see forty-seventh paper and Fig. 262.

The pressure on an axle due to the weight of the engine is not the only pressure which the axle journal has to resist; it has also to resist a pressure due to the load which the engine has to haul. The latter pressure is not a constant quantity, but the ratio between the pressure due to the weight of the engine, and that due to the maximum load is about the same in all engines; and therefore, for the sake of simplicity, we may leave the pressure due to load out of the question, and proportion the journal according to the pressure due to the weight of the engine.

Close observation and experience in modern locomotive construction lead us to believe that a pressure of about 160 and not over 175 pounds per square inch, due to the weight of the engine on the projected area of an axle journal, agrees with best modern practice and may be adopted; the former figure, namely, 160 pounds per square inch, should be preferred; it will give the best results.

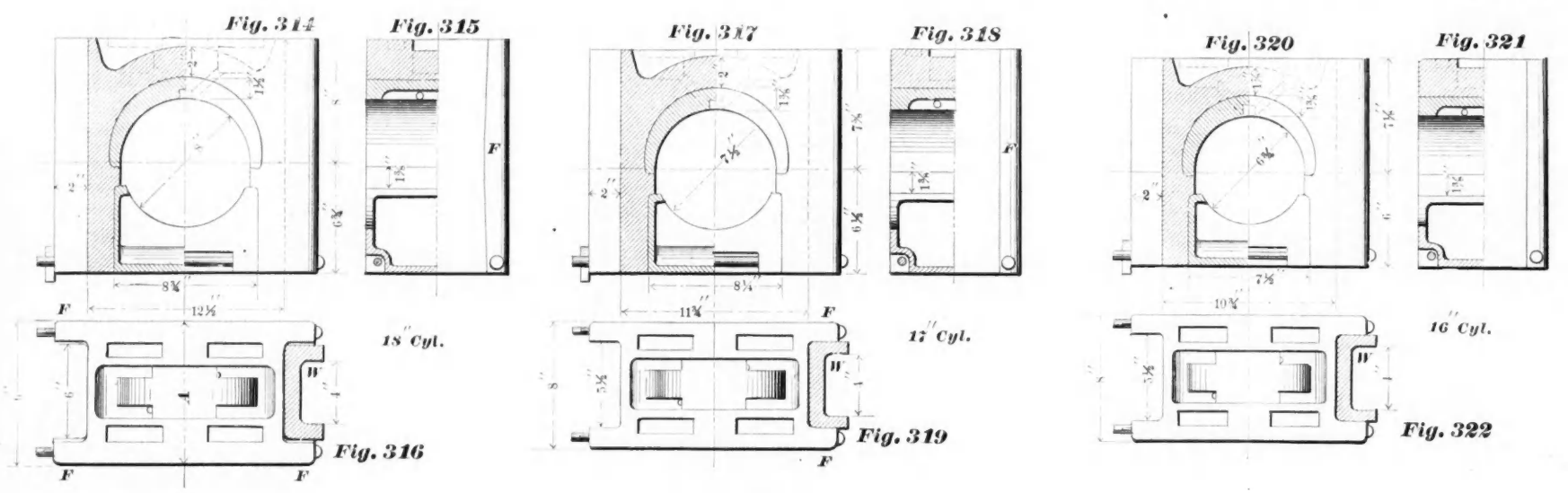
From the foregoing it will be seen that, in order to design the driving box, we must first determine the total weight which the driving axle journals will have to support.

The weight on the driving axle journals for new locomotives can generally be estimated only approximately, because the design is not sufficiently advanced to obtain the exact weights of the different parts of the engine and running gear; yet experience will enable us to estimate this weight close enough for all practical purposes. In the fifth paper, tables will be found which give the weights on drivers for the various classes of locomotives. Table 5 contains the weights on drivers for eight-wheeled passenger engines, to which we shall refer in this paper. Now, in order to determine the weight which the driving axle journals in eight-wheeled passenger engines will have to support, we must subtract the sum of the weights of the wheel centers, tires, axles, side rod, etc., in fact, the weight of all pieces which are supported directly by the track, from the total weight on drivers given in Table 5; one-fourth of the remainder will be the weight on each journal.

If the design of the engine is not sufficiently advanced to obtain the accurate weights of the driving wheels, axles, side rods, etc., we can generally estimate the sum of these weights by assuming them to be from $\frac{1}{5}$ to $\frac{1}{4}$ of the total weight on the drivers. Thus, let it be required to find the weight on the driving axle journals for an eight-wheeled passenger engine having cylinders 16 inches in diameter. In Table 5 we find the total weight on the drivers for a locomotive of this size to be 47,665 pounds. One-fourth of this weight will be the estimated sum of the weights of the parts supported directly by the track. Hence, $47{,}665 - \frac{47{,}665}{4} = 35{,}749$ pounds, which is the total weight supported by all the driving axle journals; and $\frac{35{,}749}{4} = 8{,}937$ pounds supported by each driving axle journal; or we may say that the pressure on the projected area of the journal is 8,937 pounds; and since the pressure per square inch is to be about 160 pounds, and not exceed 175 pounds, we must proportion the diameter and length of the journal accordingly. By the term "length of journal" we mean that length which is equal to the width *A* (Fig. 316) of the driving box, and neglecting the short length of journal required for the play between the axle box and hub of driving wheel.

When the driving axle is made large enough to prevent heating, and, to fulfill conditions peculiar to the locomotive, also properly fitted into the hub of the wheel, we have generally an axle strong enough to resist all the forces which may act upon it, and therefore in determining the diameter and length of journal we may throw out of consideration the strength of an axle.

One of the conditions peculiar to the locomotive, and to which a driving axle must conform, is the width *A* of the axle box (Fig. 316), which is short when compared with the lengths of pillow blocks in stationary or marine engine. This width *A* of the



axle box is limited by the distance between the cylinders and also by the gauge of the track; the latter is established, and therefore if we make the axle box too wide, and since the center of the width of frame and the center of axle box should coincide, or very nearly so, we must either move the frames closer together to a corresponding amount, and thus be compelled to reduce the width of the fire box, which is decidedly an objectionable feature, or we must increase the distance between the cylinders, which is another objectionable feature.

The width *A* of the axle box should only be sufficient to allow for the proper thickness of the flanges on the box and wedges to give these the requisite strength.

Figs. 314 and up to 341 represent driving boxes suitable for the pedestals shown in Figs. 271 up to 279 (forty-ninth paper) and are designed for eight-wheeled passenger locomotives of various sizes, including those having cylinders 10 inches in diameter, and up to 18 inches in diameter. The given dimensions of these boxes agree with the average modern locomotive practice. From these illustrations we can readily obtain the width of the boxes, and all the main dimensions. The part shown in section at the right hand side of all the plans of the boxes, such as Figs. 316, 319, 322, etc., and marked *W* in some of them, represent a section of the long wedge; the distance between the flanges of the wedges is the thickness of the frame, and this distance subtracted from the distance between the flanges of the boxes, and divided by two, will give the thickness of each flange on the wedge.

Having established the width of the driving boxes, the diameter of the journal is easily obtained by the following rule:

RULE 38.—Divide the pressure due to the weight on the projected area of the journal by 160; the product will be the number of square inches in the projected area; divide this quotient by the width *A* (Fig. 316) in inches of the driving box; the quotient will be the diameter of the journal in inches.

Ex. 69.—What should be the diameter of a driving axle journal for an eight-wheeled passenger engine having cylinders 16 inches in diameter?

We have already seen in the forepart of this paper that the total pressure on the projected area of one driving axle journal for this class and size of engine is 8,937 pounds. In Fig. 322 we find that the width of box should be 8 inches. Hence to find the diameter we have, according to Rule 38, $\frac{8,937}{160} = 55.8$, which is the number of square inches in the projected area, and $\frac{55.8}{8} = 6.97$ inches = diameter of the journal. If we make the diameter of this axle equal to that given in Fig. 320, namely $6\frac{3}{4}$ inches, the pressure per square inch on the projected area will be 165.5 pounds, providing our estimated weight of wheels, tires, axles, etc., is exactly correct.

Ex. 70.—Find the diameter of a driving axle suitable for an eight-wheeled passenger engine whose cylinders are 12 inches in diameter.

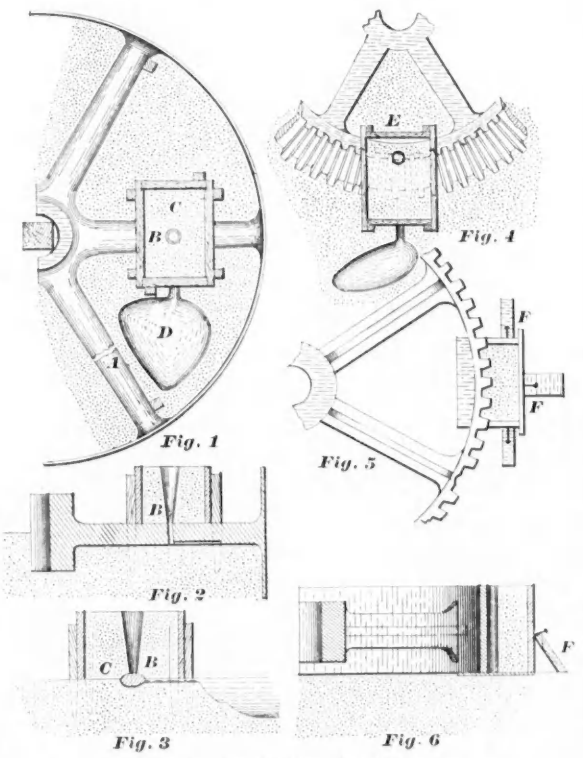
In Table 5 we find the total weight on the drivers to be 29,700 pounds. Allowing $\frac{1}{5}$ of the total weight on the drivers for the mechanism whose weight is not supported by the journals, we have $29,700 - \frac{29,700}{5} =$ 23,760 pounds pressure on all the four journals and $\frac{23,760}{4} = 5,940$ pounds pressure on the projected area of each journal. Again, $\frac{5,940}{160} = 37.12$ square inches in each projected area. In Fig. 334 we find that for a passenger locomotive with cylinders 12 inches in diameter, the width of the driving box should be $6\frac{3}{4}$ inches, and consequently the diameter of the journal should be $\frac{37.12}{6.75} = 5.49$ inches. These dimensions agree with those given in the illustrations.

From the foregoing it will be seen that in determining the dimensions of a locomotive driving axle journal, we have followed the law of simple proportionality of friction to pressure. In relation to this law, Prof. W. J. M. Rankine says: "The law of simple proportionality of friction to pressure is only true for dry surfaces, when the pressure is not sufficiently intense to indent or grind the surfaces; and for greased surfaces, when the pressure is not sufficiently intense to force out the unguent from between the surfaces where it is held by capillary attraction. If the proper limit of intensity of pressure be exceeded, the friction increases more rapidly than in the simple ratio of the pressure. That limit diminishes as the velocity of rubbing increases, according to some law not yet exactly determined. The following are some of its values, deduced from experience:

RAILWAY CARRIAGE AXLES.

	Limit of pressure per square inch.
Velocity of rubbing surface, 1 foot per second	392
2½ feet per second	224
5 " "	140 "

The limit of the pressure on journals given by Prof. Rankine is exceeded on the journals proportioned by the foregoing rules, and such as are used in modern locomotives, yet these journals are giving good results, and seem to be suitable for the purpose intended. But if the average speed of the present locomotive is to be increased, so that the velocity of the circumference of the journal exceeds 9 feet per second, the lengths of these journals may also have to be increased, so as to reduce the pressure per square inch to considerable less than 160 pounds, even if we are compelled to increase the distance between the cylinders.



Mending Broken Castings

Mending Broken Castings.

BY ROBERT E. MASTERS.

Figs. 1, 2 and 3 illustrate mending a cracked arm in a 9 foot pulley. The arm is drilled through at the crack all the way across as at *A*. Any iron between the drilled holes is cut out with a chisel to give clear passage for the fluid metal. The pulley is laid on the floor and staked. It is not necessary to ram up more of the inside than is required for a bearing for a small cope to cover the break and room enough for the pig bed as in Fig. 1. Heap sand will do to fill up with, except right at the break. A parting is made around the arm, the same as when moulding a pulley, the cope put on, staked to its place and rammed up with the gate set as at *B B*. Some might prefer to put the gate at *C*, opposite the flow-off, which is just as well if the arm has been drilled. Others, when mending a cracked arm, do not drill it, but set the gate at *C* and cut a groove in the sand in the cope and drag around the crack, to allow the metal to flow over and under to cut it out solid, and when the work is completed there is a great carbuncle around the arm that looks worse than a wrought-iron patch, and has to be counterbalanced.

When the cope is rammed up and lifted off, the pulley is hoisted from the bed and set on pieces of pig iron or small weights and a light fire built around the rim and arms, in much the same manner as a blacksmith at the crossroads heats a wagon tire to shrink it on. It is not required to heat the pulley red—just enough to have it expand well and all over alike before putting it back on the bed to burn in. It is barely possible to mend work of this kind without heating the casting, but the chances are, if the casting is not ruined there will be another crack to mend. If the arm has been drilled whether gated in the edge at *C* or on top, the sand does not have to be cut away; if the iron is as hot as it ought to be it will soon cut into the arm. We rarely use over 200 pounds of fluid metal for a job of this kind.

If the pulley to be mended is so small as not to admit of the reservoir *D* being made between the arms the iron can be conducted under the rim to a pig bed on the outside. If a part of the arm is entirely gone, no matter how long a piece, if it will pay to mend a pulley, get out a wooden arm, fit it in, and use a cope long enough to cover it and both cast ends of the arm, put a gate at each end of the break and a flow-off at the center. If the break is short, the iron poured from one ladle into a basin cut in the cope will supply both gates, but if the break is long it is best to use two ladles to cut into both ends at the same time.

Fig 4 represents burning a tooth on a bevel wheel. It is squared up a little on the floor, and the cope *E* rammed up on a good part of the rim, and the sand teeth dressed off a little, to allow for expansion; the rest of the work is treated in the same manner as the pulley. The iron running over the incline soon cuts into the rim.

Figs. 5 and 6 show putting a tooth on a spur gear. The casting is laid on a plate, and an improvised core box, made of boards braced as at *F F*, is rammed full of core sand. The inside of the rim opposite this core is filled with green sand flush with the top of the rim, to support a cope with a gate directly over the break. The wheel can be heated while the core is drying, and both be ready by the time the regular heat is being taken off, as Mr. F. H. Treacy states in his article, May 7, 1887. This method is better and more economical than to dovetail a tooth in. A hole made with a gate at the bottom of the core when ramming it up, or a groove filled in after it is dried, is an escape for the metal. We never chip the ragged part of the break at the base of the tooth, but let the fluid iron cut it away.

Two or more teeth can be burned in on this plan, or even part of a rim, by taking the impression on a sound part of the wheel and moving the broken part around to that point after the gear is heated and ready to pour. To put in a piece of rim the gear ought to be heated very hot and gated the same as when part of a pulley arm is broken out.

As this is the beginning of my fifth year as contributor to the AMERICAN MACHINIST, and as it is also the time of year to tell fairy stories, I guess I will have to relate an occurrence which sounds a great deal like the stories of big castings that some moulders are always putting up with their mouths when on the street, but which many of that class never seem able to do successfully when in the foundry.

Edward Ricketts, an experienced moulder in the Tredegar foundries, made a (solid) pinion weighing 2,400 pounds, with bearings on each end 12″ diameter by 12″ long, for a sink head. He put a common water pail on the end of the upper bearing, rammed up around it and drew it out; the lower neck of the pinion was bedded in the floor, the body of the pinion in the cheek, which was skin-dried, and the upper bearing and sink head in the cope; the flask was of wood. After pouring the pinion and letting it stand until he thought it was set, he dug around the head some and started to lift the cope off, for fear if he left the flask around it it would burn up. On hoisting a little on the cope the pinion seemed to be coming up with it, and looking between the cope and the cheek he found the casting had pulled apart at the bottom of the upper bearing next to the body of the pinion. The iron was dripping out of the bottom of the bearing. He had no idea he could save it, but, in a fit of desperation, he brushed the joint off and lowered the cope on again, and took a sledge and pounded well on top of the sink head. When shook out the next morning the casting seemed to be firmly united, and showed no sign of the break except a seam something like a "cold shut." After it had resisted a number of blows from a sledge hammer it was sent into the machine shop and finished up, then put into service in the rolling mills, and no complaint was ever made concerning it. I can vouch for the truth of this singular occurrence, and with it will close this series, wishing all a happy New Year.

LETTERS FROM PRACTICAL MEN.

The Revolving Indicator.

Editor American Machinist:

It seems to me that the article in your issue of December 24th, entitled, "The Revolving Indicator," is likely to introduce confused ideas, and ought not to be allowed to pass without criticism.

It is important that the office of the indicator, both in its extent and its limitations, should be clearly understood. The indicator is designed to represent graphically the pressure per unit of area that is exerted, through the medium of any fluid; either gaseous or liquid, elastic or non-elastic, on the opposite sides of a piston, at every point of its stroke, to produce and to resist its motion. This is its single proper use. When it has represented these opposing forces correctly its function is performed.

The diagram gives us information on two widely different subjects. The first is the distribution of pressure, the sufficiency of areas, and the functioning of valves. The second is the force exerted. On the latter subject we obtain our knowledge by computation on the basis of the diagram.

In the case of steam engines, the piston motion is commonly communicated to the revolving shaft through the medium of a connecting-rod and crank.

It is possible, of course, to so apply the indicator in these cases that equal spaces on the length of the diagram shall represent equal arcs of the revolution of the crank, as recommended in the article referred to, instead of equal distances of piston travel. Such a diagram would, by the way, have an outline very different from the one given in the article. It would, however, be of no use, except for exhibiting the relation between the piston and crank movements. The number of questions it would not answer is so great, that no one would ever take such diagrams, except for the above purpose, and then he would need a diagram from the cylinder, in order to make the comparison. But such a diagram can always be plotted from the cylinder diagram in a few minutes.

What we really need to know with respect to the crank is the rotative effect produced, or the proportion of the steam pressure at every point that is applied to the crank tangentially. This is found by a simple computation, which is made as readily from the diagram representing the stroke of the pis-

ton as from one representing the revolution of the crank.

Mr. Richards has evidently been a keen observer of the inaccuracies in indicator diagrams, and their causes, and for one I wish he would employ his vigorous pen in making them better understood and more generally avoided.

CHAS. T. PORTER.

Straddle Milling.

Editor American Machinist:

I read with great interest Mr. John J. Grant's paper on "The Milling Machine as a Substitute for the Planer in Machine Construction," and also your comments on the same.

I think Mr. Grant's method of milling those pieces of cast iron can be very much improved, and the planers beaten "out of sight." Instead of milling them with a plain spiral cutter, why not straddle mill them, and finish two sides at a time and with one cut, instead of one side at a time and two cuts to each side? which I infer is the way the pieces 16″ long by 1½″ by 1″ were milled.

I once had a number of pieces ⅝″x⅝″x12″ long to mill (cast-iron), and proceeded as follows: I had two milling machines, and one apprentice boy in charge of same. We held the pieces, two at a time, in the vise of one milling machine and milled off one side of each. In the second machine he held them in a fixture and straddle milled them to size. When finished they did not vary $\frac{3}{1000}$ of an inch. A short time after I milled a second lot and omitted the first milling, with spiral cutter, and got good enough results—within $\frac{3}{1000}$. The cost of milling was less than one-fourth of what it formerly cost to plane them. K.

[Of course straddle milling is always to be employed when the circumstances are such as to admit of its use, and of course Mr. Grant fully appreciates that fact. But straddle milling has its limitations, and for milling such pieces as are under discussion, and which must be straight as well as accurately sized, it is not usually found to be satisfactory, on account of the springing of the pieces while being milled. And of course all work of that kind, which must have practically straight and true surfaces, must have more than one cut taken over it, no matter how the metal may be removed, because one of the chief causes of springing in such pieces is with the pieces themselves.]

Experiments with Steel.

Editor American Machinist:

In your description of the experiments made by Mr. Coffin before the Society of Mechanical Engineers, at Philadelphia, where he joined two pieces of tool steel by the aid of a Bunsen burner, you say that Mr. Coffin "cut a small steel bar in two pieces, heated the ends to a red heat by means of a Bunsen burner and pressed them together with a pair of tongs." As such a process must result in failure, I take the liberty to state the case as I saw Mr. Coffin present it. A piece of hardened tool steel, perhaps ¼″ or $\frac{5}{16}$″ square and about 1½″ long, slightly nicked midway between the two ends, was broken at the nicked part; the two parts were quickly adjusted to each other where the fracture occurred, put under pressure in a pair of tongs and then heated to a bright red with the result stated.

I do not think that this experiment illustrates any action which may take place between the crystals of steel at a hardening temperature; it simply shows the common quality of matter to adhere to corresponding matter when the conditions are made favorable. If Mr. Coffin had allowed a film of oxide to form before clamping the two broken ends, or had there been a less perfect contact than such as is formed by breaking hardened tool steel, his experiment would certainly have failed. What Mr. Coffin has shown is this; when two surfaces of tool steel perfectly matching each other, free from oxidation and from all foreign matter, are heated under pressure to a red heat, they will stick together, or come into molecular contact more or less perfectly, according to the care taken to have the surfaces perfect and free from foreign matter.

During the experiment, Mr. Coffin remarked that sometimes the action of the gas flame interfered with the success of the experiment, and because of this he wrapped platinum foil around the parts to be joined during the heating process. To me this clearly shows that even when the surfaces are well matched and under great pressure, oxidation is liable to take place. This, I think, is well illustrated by the margin surfaces of the specimens shown. The frosted appearance spoken of may be, and often is, produced on finished surfaces of soft steel which are in close contact and under pressure. I have put together many thousands of broken pieces of hardened tool steel, and heated them under pressure of the most favorable kind, but I have seldom seen them free from oxide over the whole of the contact surfaces. Those of the pieces which showed the least oxide invariably offered the greatest resistance to separation; this resistance, however, has never been so great as that shown by Mr. Coffin's specimen, on account of the heat applied not being so great as it was required to draw them to a blue temper only.

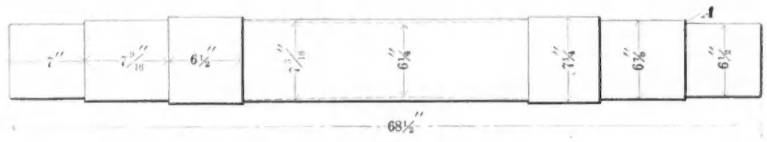
Incidentally, I would mention that the practice of putting hardened steel under pressure during the process of drawing the temper, can only be successful when the pressure is applied before heating and continued during the application of heat. There is a critical temperature at which—during the process of drawing the temper, and before the color comes to any perceptible degree—hardened tool steel will yield permanently to pressure, and thus permit the errors due to hardening to be corrected. At this critical temperature—which may perhaps have a range of several degrees—the molecular structure of the steel is so changed that almost all internal strains disappear, and the strength of the steel is greatly increased.

T. R. ALMOND.

Locomotive Driving Axles.

Editor American Machinist:

I took considerable interest in the letters of different master mechanics that you published early in the year regarding the use of (they did not write anything about the abuse of) steel for locomotive driving axles. I enclose sketch of two that have been taken out of engines with 16″x24″ cylinder, 48″ boiler, here within three weeks. Each of them broke at the end of the wheel fit marked *A*, and the wheels were left by the roadside. Both were forward axles, and there was only a small portion of the center of each that held at the time of dropping off, the outsides of the break having rubbed together until they were smooth. They were both cast-steel of a well-known make. One had run about twelve years, most of the time on heavy freight work, and the other about five years on heavy passenger work.



LOCOMOTIVE DRIVING AXLES.

I believe that if the middle part of those axles had been cut down to the dotted lines in the sketch, and the shoulders at *A* been round instead of square, those axles would have been running now, but there is evidently a difference of opinion, as they were replaced with more of the same kind, which, by the way, are put into all sizes of engines from 14″x22″ cylinder and 44″ boiler to 16½″x24″ cylinder and 50″ boiler.

E. W. COMSTOCK.

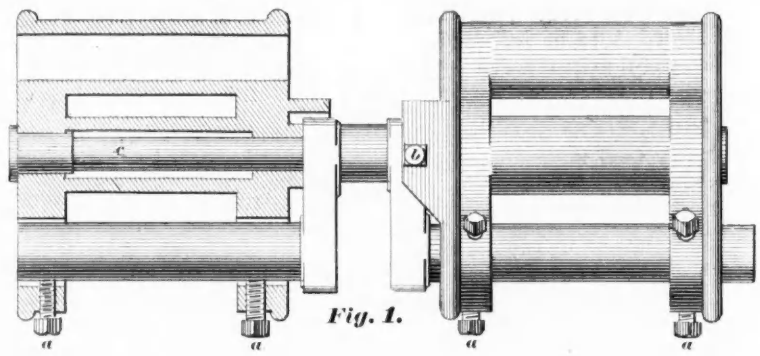


Fig. 1.

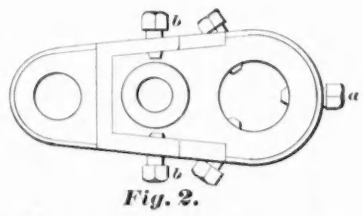


Fig. 2.

DEVICE FOR TURNING CRANK-PINS.

Device for Turning Crank-Pins.

Editor American Machinist:

I send you by mail to-day blue-print sketch of device for turning pin in center crank engine shafts.

As the experience of every workman has demonstrated that it is a very difficult matter to obtain a true crank-pin and avoid springing of shaft with ordinary centers, this will, perhaps, be found of value to manufacturers building that class of engine.

Fig. 1 represents centers on shaft with sectional view at one end. They are made of cast-iron with hardened centers *C*, fitted in carefully, so that all strain comes on center line of crank-pin, one side being cut hollow to admit of weight to counterbalance crank of different weight.

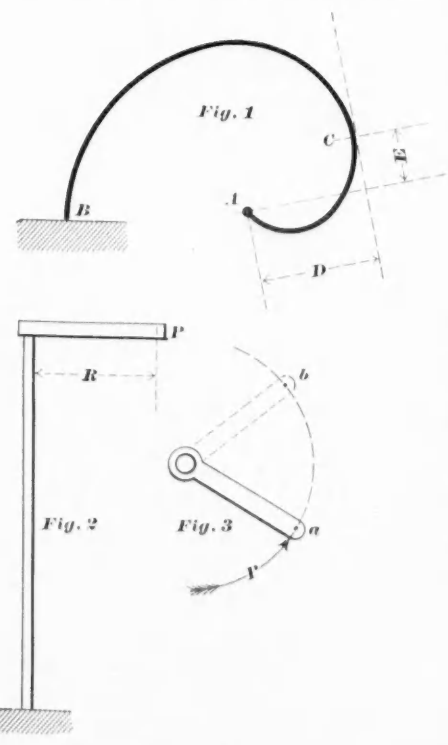
The crank is grasped firmly by bell portion, thereby causing strain to fall on center of crank-pin and avoiding the possibility of springing the crank at the neck. These centers are readily adjusted, consequently much time is saved.

To use them, slip the centers on the shaft and swing the whole on the lathe centers; bring the shaft parallel with surface gauge from lathe carriage, tighten up the set screws *a* on shaft; then adjust the crank-pin with set screw *b*. When turning a lot of cranks, in taking off use only set screws *a* and *b* on one side of bell face of crank. Each succeeding one will be a duplicate of the first.

Fig. 2 represents end view of centers as fastened on shaft on wrist pin. They can also be made with taper sleeves, slotted and threaded, so that long ends of shaft can be turned first, and injury to shaft by set screw be avoided while turning pin.

These centers were gotten up by me, and there is no patent on them. They have been given a fair trial and found superior to any we have yet used.

M. J. TRESCH,
Foreman of Central Iron Works, Bradford, Pa.



SPIRAL SPRINGS.

Formulas for Spiral Springs.

Editor American Machinist:

In reference to Mr. Mackintosh's inquiry in the AMERICAN MACHINIST of December 10th, I would say that my experience with spiral springs is not very extensive, but enough so to make it of value, and I am glad to be able to contribute in any degree to the general knowledge on this subject. A spiral spring, when loaded, is in the same condition as a straight piece of steel fixed at one end and twisted by turning a lever or wrench attached to the free end. To make it clear that this must be so, I have, in Fig. 1, shown a piece of bent steel, fixed at *B* in a horizontal position, and a weight applied at *A*. The stress produced by the weight *A* at any point, for instance at *c*, can be found by drawing a tangent to *c*, and from *A* a perpendicular to the tangent, as shown. The line *D* will then represent the twisting stress and *E* the bending stress at the point *c*. That is to say, the steel will be twisted as well as bent, and the twisting moment is equal to the weight *A* multiplied into the distance *D*, and the bending moment is equal to the weight multiplied into the distance *E*. When the curve becomes a circle, with center at *A*, there will be no bending moment; all the stress will be torsional and every part of the circle will be subjected to a twisting moment equal to the weight multiplied into the radius of the circle.

Now, a spiral spring may be considered as a series of concentric rings, and every particle of the spring will, therefore, be subjected to a twisting moment equal to the load multiplied into the radius or half the mean diameter, with the exception of that part which is not a true circle, and which generally may be left out of consideration or treated as part of a circle.

We will now take a straight piece of steel, clamp one end and keep the other end in a bearing so that it cannot move sideways; then screw a lever to the free end and apply a force *P* to this, as shown in Figs. 2 and 3. If the distance of *P* from the center of the rod is *R*, then every part of the rod will be subjected to a twisting stress whose moment is *P* multiplied into *R*; and this rod will therefore be in exactly the same condition as a spiral spring with a mean diameter of 2 *R*, under a load *P*; and if the rod be wound into a spiral spring of that diameter the deflection caused by a load *P* will be equal to the length of the curve *a b*, which is the deflection of the straight rod measured on a radius *R*.

On this base it is a pretty easy matter to compute a formula for the deflection and carrying capacity of spiral springs. The formula for the deflection must always contain the fourth power of the diameter of the steel and the third power of the diameter of the coil, and Mr. Mackintosh's formula can, therefore, not be generally useful, although it may, for certain proportions, give fairly good results.

The mathematically correct formulas for the carrying capacity of spiral springs are:

$$W = .383\ \frac{S\,d^3}{D_0}$$ for round steel,

and $$W = .471\ \frac{S\,d^3}{D_0}$$ for square steel,

and for the deflection of one single coil:

$$F = 8\ \frac{P\ {D_0}^3}{E\,d^4}$$ for round steel,

and $$F = 4.712\ \frac{P\ {D_0}^3}{E\,d^4}$$ for square steel.

Where W = carrying capacity, in pounds.
S = greatest tensile strength per sq. inch of material.
d = diameter of steel.
D_0 = mean diameter of coil.
F = deflection.
E = torsional modulus of elasticity.
P = any load or pressure on the spring, in pounds.
All measurements in inches.

I have now come to Mr. Mackintosh's question, What are the values of S and E?

Last winter I saw the record of a test of spiral springs made by a spring maker in Pittsburgh. There were two sizes: $5\frac{1}{8}''$ outside diameter of $1''$ round steel, and $3''$ outside diameter of $\frac{5}{8}''$ round steel. By the use of my formulas I found the greatest tensile stress to which these springs were subjected to be 124,000 and 126,000 pounds per square inch of material and from this I concluded that $S = 60{,}000$ would give a safe carrying capacity and $S = 120{,}000$ would not be too high a factor for the ultimate capacity.

I found the modulus of elasticity to be 14,400,000 for the big spring, and 12,060,000 for the smaller one, but these figures are not reliable, for I did not measure the springs myself, nor am I quite sure that I had the exact number of coils. The big spring had only about three coils between the two end coils which were flattened, and should not be counted, and a little mistake in the counting of the coils would therefore give quite a different result. Afterwards I had some springs made myself of $\frac{1}{4}''$ and $\frac{5}{16}''$ round steel. In calculating these springs I used a modulus of elasticity of 12,000,000, and I struck a very good average, as will be seen from the following. The first spring I had made was of $\frac{1}{4}''$ round steel, $2\frac{3}{4}''$ outside diameter, with nine coils, flat ends not counted. The calculated deflection of this spring was .2666 inches per coil, or 2.3994 inches for nine coils by a load of 100 pounds. The actual deflection was $2\frac{1}{2}$ inches, which gives a modulus of elasticity of 11,520,000. If the steel had been .258 inches instead of .25 inches, or if the diameter had been 2.715 inches instead of 2.75, the deflection would have been exactly as calculated. A little difference in thickness of the steel makes considerable difference in the amount of deflection.

The next spring was $3\frac{3}{8}''$ outside diameter of $\frac{5}{16}$ inch round steel, and had ten coils. The calculated deflection was .207 inch for one coil or 2.07 inches for 10 coils. The actual deflection was $2''$, which gives a modulus of elasticity of 12.047,000.

The next spring was $2\frac{5}{8}''$ outside diameter, of $\frac{5}{16}''$ round steel, 18 coils; calculated deflection .0864 inch for one coil, or 1.555 inches for eighteen coils. The actual deflection was $1\frac{1}{2}''$, which gives a modulus of elasticity of 12,300,000. Besides these springs I had one made of $\frac{5}{16}''$ round steel and $3''$ diameter, which came as near the calculated deflection as the rest of them.

I have no experience with heavier springs, so I do not know whether the modulus of elasticity is the same for all sizes of steel. The smaller sizes have been rolled more than the larger sizes, which might have some influence, but I would be slow to accept that theory. It is more probable that there will be some difference in the elasticity of rolled and drawn steel. If springs of different sizes of steel which had been tested and found of equal elasticity could not be calculated by the same formula, then this would indicate that some empirical element had to be introduced in the formula; for instance, a constant bearing a simple proportion to the diameter of the steel. Whether this will be necessary remains to be seen. A formula based on pure mathematics is the best one, for if it gives good results for two different sizes it will give equally good results for the intermediate sizes, which is not the case with empirical formulas. I have no reason to believe that an empirical formula should be needed for springs.

J. BEGTRUP.

Keeping Engines in Line.

Editor American Machinist:

There are many engines running, the belts of which are short for the speed. The belt must be kept taut, and, among other evils, the tendency is to pull the engine shaft out of line. Having charge of an engine working under such conditions, I had to be very sure the shaft was square with the cylinder. I thought of this plan, which may be of service to others: After lining up the engine, and knowing the shaft was square, I put a center punch mark on the bed at a point directly opposite the rim of the pulley. Then I took a piece of $\frac{3}{16}''$ wire, bent one end to a right angle and filed to fit punch mark. Then placing the pointed end in punch mark, I fitted the other end to just touch the edge of the rim of the pulley. Then I marked the place on the pulley, and thus I had a guage by which I could detect the slightest pulling out of line. But two things must be assumed; the pulley or flywheel must remain fast to shaft, and the gauge must be used at one place only on the wheel; also the side motion of the shaft should be taken up in one direction, as towards the engine.

T. T. PARKER.

Engineering gives an account of a new steamship just completed for the North German Lloyds called the Lahn, intended to ply between Bremen and New York.

The vessel is of steel, 448 ft. by 49 ft. by 36 ft. 6 in. The engines are of a new type, this being the first vessel into which they have been introduced.

The engines have five cylinders, working upon three cranks. Two of the cylinders are high pressure, $32\frac{1}{2}$ inches diameter, there is one intermediate 68 inches diameter and two low pressure 85 inches diameter. The stroke is 6 feet.

Steam is supplied by six double-ended boilers of steel, and designed to carry a pressure of 150 pounds.

On the trial the engines developed 9,500 horse-power, and the speed attained was 19.46 knots per hour, thus ranking her third among the vessels in the Atlantic service in point of speed.

De Lesseps—"Yes, we are still working on the Panama canal and have got hopes. By the way, you have the advantage of me."

American Tourist—"My name is Keely."

"Ah! The Keely who is inventing a new motor?"

"The same."

"How fortunate we have met. When my canal is completed I will use your motors to run our towboats."—*Omaha World.*

The falling through the air of an immense stone at Amsterdam, N. Y., which fact was duly chronicled by the daily press, as was also the fact that traces of various metals were found in the stone, afforded opportunity for considerable speculation. But when it was found that the stone fell from a wagon, the ardor of those who were building upon the phenomenon was materially abated.

The authorities are not moving fast enough to satisfy the people in the matter of coast defense. The way to avoid war is to be prepared for it There is yet opportunity for inventors in this direction.

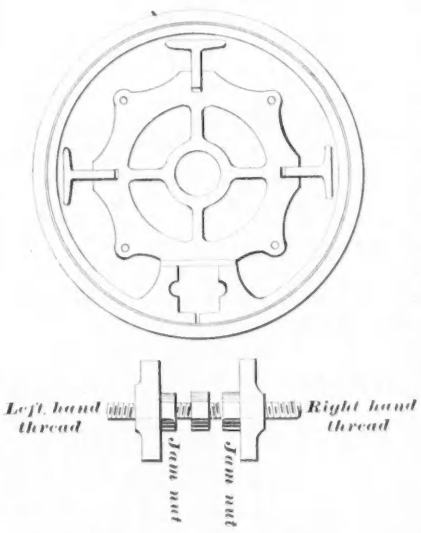
Just at this time, when it is concluded in New York that the elevated roads do not afford rapid transit, Chicago is moving to establish such roads for that purpose.

Investigations have been made, showing that a day of fog in London costs the citizens about $38,400 in extra gas consumed.

Steam Engine Pistons.

BY. WM. J. WILLIAMS.

Probably no part of a steam engine is more unsatisfactory than the piston. In almost any other part the design would not be subjected to such adverse criticism. It seems to be a fair target for firing arrows of animadversion against. Simple as it may seem to be to make and keep a steam tight joint, and notwithstanding all the different devices thus far brought to notice, there seems to be a void not yet filled. It is said of Mr. Watt, that to obtain a steam-tight piston was one of his chief difficulties. To what straits he must have been put when the idea suggested itself to him of using leather as a packing. The greater number of pistons are adjustable; that is, the rings are capable of being sprung or forced against the whole circumference (or at least that is the intention) of the walls of the cylinder by some device. But to do so necessitates two distinct operations, each of them equally important. It cannot be said, first attain one object and then accomplish the second, for they are done together—setting out the rings and keeping the piston head central. To keep the same tension on all parts of the rings is a thing easier said than done, sometimes, for usually the piston head does not want to stay central. When it is uninfluenced by the device employed for setting out the packing, the head is either to the right or left of the center of the cylinder. This is not confined to horizontal engines; the same thing occurs in a vertical cylinder, and during the operation of setting out the rings the piston head persists in retaining its original



STEAM ENGINE PISTONS.

position. But it is forced central in the act of setting out the rings, and when the job is finished, on striking the springs or trying the wedges, some will sound as solid as an anvil, whilst others indicate anything but solidity or equality of tension, and it is not always certain just what has been done. In reference to the tendency of the piston head, when free from restraint, not to assume a central position, it has been a matter of discussion as to whether it is the proper thing to do, to compel it to do so, the negative side reasoning that, wherever a piston head inclines to rest in the cylinder, it should be allowed to so remain during the setting out of the packing, and that its assumed position shows that it is in line with its connections, and will move through its path in a parallel line with the walls of the cylinder, while, if forced to take another position, it would not move in a straight line. To prove their faith in this reasoning, they practice it, and the cylinders thus treated, will, as to condition, compare favorably with any others.

If the question was asked of a large majority of persons, supposed to be acquainted with the subject, Which would be the largest diameter of a steam cylinder that had done service for some definite period of time? the answer would be, its vertical diameter; yet there are well authenticated cases where the transverse diameter has been the largest. Various theories have been presented for the causes of the usual wear of cylinders, but they seem to be clouded with considerable doubt. Some cylinders have been used for years, with no perceptible wear in any direction to make them untrue. If one cylinder wears true, why not all? The answer may be relegated to the company of a multitude of other questions that have never been satisfactorily answered. To account for the cause why a cylinder should wear, so that its transverse diameter is larger than its vertical, looks a good deal like an impossibility. A theory will be advanced for the cause, and may be made to do until a better one is offered.

To return to the piston head, which, when in a state of rest, is not central with center of bore of cylinder, but is made central in the course of setting out the packing rings, considerable more tension is required of the springs or other devices on the side of the cylinder towards which the piston head would remain if it were allowed to do so. This extra force is felt on one side of the cylinder only; consequently that portion of the circumference of the bore of the cylinder is subjected to a wear that the opposite side is not; the piston's weight may be said to be held up at the sides. Under such conditions the cylinder would be apt to show, in the course of time, a larger transverse than vertical diameter.

It is now about ninety years since the first metallic-packed piston was invented, and they keep on being invented yet, requiring the same general manipulation for their adjustment, doing two things at once, where, if only one were done at a time, the operation would be simplified, and would, in all probability, be much better done. The enclosed sketch is the result of some thought on the subject. Possibly it is not an original thought; it may also be said of it, that the means to set out the rings would make it of too unyielding structure for a steam piston—not more so than some that could be mentioned—or that it might do if a cylinder could be bored parallel. Well, if this cannot be done yet, it is high time it could be; especially such length of cylinders as is now the order of the day. In the old way of building a piston the follower was not fitted to grip the rings and help hold them to their position, but was supposed to be so fitted that a steam-tight joint existed between the follower, also piston head and rings, so as to allow the rings to be compressed inwardly in case there was any part of the cylinder smaller than another. It was quite a nice operation to so fit them, requiring a little finer work than is generally found about any part of a steam engine. The consequence of this kind of fitting, was that, from the very start, there was a constant abrasion going on between rings and followers, and after a while the outer rings for some distance back from where they were cut did not touch the cylinder at all, and even showed an appearance of being upset from want of support. Such pistons are not a success at all times, especially if they happen to be in a cylinder that has a cold end. I once saw an example of that kind. It all came about from being late that morning, and in his hurry to get started, the engineer did not do as was his custom, that is, warm up both ends of the cylinder. He just gave the engine a dash of steam and drove the piston part way through the cylinder, and there it stuck, and would neither advance nor recede. Fortunately there was a person at hand of larger experience and a cooler head, and time and patience, with a judicious use of steam applied to both sides of the piston, finally got things into working shape That part of the cylinder occupied by the piston was the critical point to get warmed up and expanded; this was done by heating each side of the piston in turn; the piston transferring its heat to that part of the cylinder enclosing it, and finally heating it enough to expand it and let go, as it were, its grip of the piston. The party who got into the trouble knew nothing of the cause, why he got where he did; the party who relieved him of his predicament found it by general appearances and a few questions as to what was done and what was not done that morning.

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The Machinery Trade.

We publish elsewhere in this issue letters from several representative manufacturers and dealers in machinery in different parts of the country, to which we invite the attention of those of our readers who are interested in the business prospects for 1888. They are far more valuable for this purpose than the opinion of any single individual, however carefully formed, because they voice the judgment in this matter of a number of men, who, so to speak, have their fingers on the pulse of those who buy and use machinery. The expressions are those of men trained as far as possible to forecast the future probabilities in the machinery business of the country.

It is pleasing to note that in nearly every instance the writers of these letters look for increased business in 1888. In a few instances fear is expressed that business may be endangered by adverse tariff legislation, but we trust and believe this fear is groundless. Those who are to legislate upon this question are fresh from the people and know their views, and besides, they are, it must be assumed, interested first and foremost in the welfare of the whole country. We have faith in their wisdom to avoid any inconsiderate action that shall endanger our great and growing manufacturing interests. The fact that a fear exists in that direction will tend to make them all the more careful in dealing with what is always an exceedingly delicate question.

We can see nothing whatever, in the way of the steady growth of the machine business so generally predicted by those who favor us with their views. This opinion is based mainly upon the reports of the volume of business for 1887. It will be noticed that in nearly every instance it exceeded that of the year before. This is a simple statement of fact, and not a matter of opinion. It is plain that, assuming the business represented by the writers of these letters to be fairly representative, which we believe it to be, there was a steady and healthy growth in the machinery trade during 1887. Unless something unforeseen occurs to check it, it is reasonably certain that this growth will continue during 1888.

The cost of material and labor have undergone no noticeable change during the year. Prices of tools and machinery have not advanced. While these prices, we believe, are lower than they should be, there is in the way of compensation the fact that for those in need, it is an excellent time to buy. It is within reason to believe that prices will be advanced during 1888.

We congratulate all—manufacturers of machinery and mechanics working in that line of manufacture—upon the excellent prospects for the year before them. To-day they look better in every way than they did one year ago; next year at this time we trust they will look better than to day.

Machine vs. Hand Work.

A great deal is being said and written about the advantages of the employment of machinery in place of hand labor, which is entirely misunderstood by those who are not mechanics, or at least intimately familiar with mechanical operations. We constantly see such expressions as "the substitution of the unerring accuracy and uniform action of a machine, for the uncertain and ever varying hand labor." Now, such an expression, while in one sense it is true enough, is, nevertheless, misleading to those not familiar with such matters.

It is not true, except in very rare instances, that a machine will produce work of better quality or greater uniformity than can be produced by hand labor, and the machines are usually employed simply because they will produce work of the quality and uniformity desired at a much less cost than would be the case if the grade of skilled hand labor required to produce equal results were employed. Many of the parts of small machines, such as sewing machines, were formerly filed to shape and size, the quality of the work and its uniformity depending upon the skill of the filers, who were not the highest of skilled workmen. This process has been superseded by milling machine, and other operations, by which the cost has been reduced, the quality greatly improved, and greater uniformity secured. But the tools, milling cutters, gauges and other appliances, by which this result is secured, are made by the highest skilled labor, and if this grade of labor were employed upon the pieces themselves, they could be made of better quality and greater uniformity than it is possible to secure by machinery.

When a new sewing machine, or a new gun, or any similar article is invented or designed, which is to be made in large numbers, it is the usual practice to first build a sample or model machine, which, when finished, is put to a practical test. When found to be entirely satisfactory it is taken apart, and the pieces which composed it used as samples, by which the gauges, jigs, templets and fixtures are made, by means of which the thousands are to be produced. Now, for the building of this model machine the highest skilled labor is usually employed, and it is fully equal to, if not superior to, any which are afterwards produced by machinery. And, moreover, the same labor could produce a duplicate of this machine, but it would cost, perhaps, a hundred times as much as those produced by machinery, and this is, after all, the real reason for the employment of machinery.

So much has been said on this subject that many will hesitate to believe that there is scarcely anything produced by machinery which cannot be improved by skilled hand labor, if there are economic reasons for such improvement; but, nevertheless, it is a fact. Take, for instance, the apparently simple matter of the production of a true flat surface upon a piece of cast-iron. It is well known among mechanics that the best of such surfaces are produced by skilled hand labor, and all that the best machines can do is simply to rough out, or prepare the surface for the hand labor, by which it is perfected.

There are plenty of machines which will produce holes in steel with a great degree of precision and uniformity, but far superior holes can be produced by hand lapping, and can be had by anyone who is able and willing to pay for the increased cost.

Transits, theodolites, levels and other instruments must depend for their accuracy upon the skill of the mechanic who makes them. It is safe to say that the degree of accuracy which is required upon such work will always require skilled hand labor, and can probably never be attained by machinery.

Much has been said on this subject in connection with the manufacture of watches, and the introduction of machinery has accomplished wonders in this department of industry. But, notwithstanding all that has been done, if one wishes to procure the best watch which it is possible to produce, and *is willing to pay for it*, he must buy a watch which has been made, or, at least, perfected, by skilled hand labor.

Up to a certain degree of precision and excellence, machinery is superior to hand labor, but usually only for economic reasons, and it is not true, as many seem to think, that the very highest degree of precision is obtained by machine operations.

We briefly referred, last week, to the formation of a society of foundry foremen, patterned somewhat after the Society of Mechanical Engineers. The idea of forming such a society is an excellent one. There is plenty of valuable work ahead of such a society, and it should receive encouragement from manufacturers and others. Foundry art has been sadly neglected, and it is only within the past ten years, or less, that foundry literature has been built up. Building up this literature, and incidentally the fostering of the reading habit amongst moulders, is mainly due to a very few progressive foundrymen, who have given their ideas to the world through the technical press. And during these ten years the foundry has correspondingly increased in importance, and the new society referred to will tend to still further elevate it. It is useless to try to do the thinking required in a foundry in the office or somewhere else than right on the floor. The more foundrymen read and study, the more they excite emulation by societies of the kind referred to, the more they will advance the importance of the foundry as a factor in manufacturing. We wish the new society every success that hard, honest work may bring.

Some of the inventors evidently do not propose to give up the car stove. Several of them have invented and patented extinguishers in the shape of water tanks, which, when anything happens, drown out the fire in the stove. Some of them act automatically, while others must be operated by pulling a cord, which is supposed to flood the stove and render it innocuous, so to speak.

We do not hear much in these times of perpetual motion, and the mechanic who indulges in such a scheme gets rather mercilessly derided. A knowledge of mechanics tends to establish the impossibility of getting something for nothing. But there is little lack of men with money who will invest it in impossible schemes that are outside of all reason. These men are like the mechanic who believes in perpetual motion; they expect to get something for nothing.

QUESTIONS AND ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(1) In our answer to Question 529, issue of Dec. 24, 1887, an error occurred. Where we say 300 revolutions we meant to say 206 revolutions.

(2) G. A., Oil City, asks: Can you give me a rule for the formation of gear teeth? If any such have been published in the AMERICAN MACHINIST please state what numbers. *A.*—We cannot give such a rule without an illustrative diagram. An article treating of this subject will be published in our columns before long.

(3) D. E. F., Mobile, Ala., writes: Will you kindly inform me if metals can be analyzed. If so, where can it be done, and what will it cost? *A.*—Metals can be analyzed. Take it to a chemist who makes this a specialty. As to the cost, that will depend on the standing in the profession of the chemist. If he is a man of renown he will charge more than those just entering the profession.

(4) J. S., Philadelphia, Pa., asks: What metal will expand and contract with 104° of heat so as to raise a valve and keep the same heat? *A.*—Your question is not plainly put. Zinc will expand and contract the most under variations in temperature; brass will expand and contract considerably more than iron. Perhaps brass will answer your purpose. We cannot advise more definitely without knowing what you are trying to do and how you propose to do it.

(5) J. N. B., Brantford, Ont., asks: What size should a boiler be (locomotive type) for an engine 9″ x 11″, making 200 revolutions per minute? What amount of grate surface should there be? *A.*—You do not give the steam pressure per square inch, but assuming the mean effective pressure to be 60 pounds per square inch, we would recommend, for natural draught, a grate surface of 18 to 20 square feet: make the heating surface equal to 20 to 30 times the grate surface.

(6) Kanuck, Toronto, Canada, asks. Will you please give me a receipt for making a good cement for fixing on rubber tires on bicycles? *A.*—Soak pulverized gum shellac in ten times its weight of strong ammonia, when a slimy mass is obtained, which, in three or four weeks, will become liquid without the use of hot water. This softens the rubber, and becomes, after volatilization of the ammonia, hard and impermeable to gases and fluids. Manufacturers of bicycles may use a better preparation or cement. We would advise to write to one of them.

(7) J. G. T., Corvallis, Or., writes: 1. At the present are steel boilers selling at the same price of iron ones? *A.*—There may be manufacturers who sell both kinds of boilers for the same price, but these must certainly have a larger profit on iron boilers than on steel boilers. If the profit is about the same on both, then the steel boilers will cost more than iron boilers? 2. What is the objection to steel for boilers? Is not steel coming more into general use for boilers every year? *A.*—There are no objections to the use of steel for boilers, excepting it is the price of steel

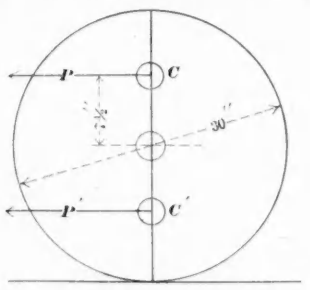
We certainly prefer steel boilers; they are the best, and are coming into more general use every year.

(8) **Reader, Indianapolis, Ind., writes:** I want to cut a gear wheel with 202 teeth, and have no change wheels for gear cutter suitable to do the spacing. How can I do it in the gear cutter, with, out spacing by hand? *A.*—We know of no way unless you procure the proper gears for spacing.

(9) **R. J M., Batavia, N. Y., writes:** I am 15 years' old and expect to begin learning the machinist trade next month, with the view of becoming a locomotive engineer. I would like information as to the best elementary books and papers relating to subjects that will fit me for the trade. *A.*—Study elementary geometry, mensuration, and drawing, also obtain a fair knowledge of algebra, then take up a good elementary treatise on physics, and books relating to the strength of material. Also read practical books which treat on the locomotive, such as, "Locomotive Engine Running," by Angus Sinclair; "Cathecism of the Locomotive," by M. N. Forney; Modern Locomotive Construction, and Practical Drawing, in the AMERICAN MACHINIST.

(10) **H. M., Columbus, O., asks:** 1. What are primary and secondary batteries? *A.*—Primary batteries are those which generate an electric current. There are many forms, that which is composed of one or more Leyden jars being perhaps the most familiar. Within the space available in this column it is not possible to fully describe the nature of the secondary battery. Its name indicates, and in effect it really is a battery, which, instead of generating electricity, merely receives it from another source, to be again given out. In some cases, however, this is effected by means of reconverting electricity into chemical energy, which, by proper arrangements, may be turned back into electricity. You will find the subject fully explained in works on electricity. Your other question we will answer as soon as we can obtain information upon the subject which is reliable.

(11) **A. B. A., Indianapolis, Ind.,** writes: I send herewith a sketch illustrating a problem which I have agreed to submit to you for solution. The sketch represents a car wheel 30 inches diameter. The car with its load is supposed to weigh 6,000 pounds. The power *P* is made fast to the car, and is supposed to act in a direct line on wrist pin *C*, and power *P'* to act in same direction on wrist pin *C'*.



How much power will it take to start the car at *P*, and how much at *P'*, and what difference will there be, if any? *A.*—It is not possible to tell just how much power would be required to start this car, but the force required to start a railroad car is given by an authority as .004 × weight; though we regard this constant as too small for the conditions you state. According to this, if you have the same conditions as to friction, etc., a force of 24 pounds will be required to start it, but as the power is applied at a point 7½ inches from the center, which is ½ the radius of the wheel, the force required on the wrist pin would be 48 pounds. There would be no difference in the amount of power required, whether it is applied at *C* or at *C'*.

(12) **We have received a communication** from a correspondent in Binghamton, N. Y., who seems to think there is something wrong with our answer to Question 507, issue of Dec. 17, in which we say that ¼ the size of a brick 2" x 4" x 8" would be ½" x 1" x 2". He asks: Don't you think there is something mathematically wrong in "the general understanding and practice among mechanics" when they call 1-64 of a thing ¼ of it? Or, in other words, how can one cubic inch be ¼ of sixty-four cubic inches either in size or quantity? *A.*—Of course one cubic inch is not ¼ of 64 cubic inches, neither did we claim it to be. We stated what is the general understanding and practice among mechanics in these matters. Although we had nothing to do with the establishment of the custom, and consequently are not responsible for it, yet we think it is founded upon the plain common sense of the matter, and is right. A standard brick 2" x 4" x 8" contains 64 cubic inches; now a brick containing ¼ as many cubic inches would measure 1.26" x 2.52" x 5.04", but no mechanic would think of making it that size. But this is a simple case compared with the one which would arise if a model of a complicated machine were ordered ½ size. Would the mechanic be expected to compute the cubic contents of each wheel, lever, screw, and all the other parts of the machine, divide the results by four, and then make the parts of the model according to these figures and in the same proportion as the machine? We think not. If you have a lathe of 20" swing and order one one-half as large, you will receive one of 10" swing, not one having one-half the cubic contents, and that is probably what you would expect to receive too.

(13) **F. H., Philadelphia, asks:** What causes pulleys to chatter in the turning? We have a lathe in the shop which will not turn pulleys without chattering. Several first-class workmen have tried it and failed. It is a 48-inch lathe, but swings 34 inches only over the carriage, and pulleys exceeding that diameter can be turned only by means of a rest reaching out from and bolted to the slide rest. This rest reaches out 14 inches, and has nothing to support it but its bearing on the slide rest. But it also chatters on pulleys which swing over the carriage, therefore the unsupported rest cannot be the cause. We have used one and two drivers, tools without and with top rake. We have fed to and from the face-plate, with feeds varying from 32 to 4 per inch. We have also tried spring tools. It chatters least at slow speeds. The face-plate has a gear 75 teeth (about 18 inches diameter) fastened to the back. It is driven by a pinion of 13 teeth which are worn to one-half their original thickness. This makes an irregular motion, and its effects may be seen on any finished surface. The spindle is out of round, and I don't see how the boxes can be any better. What I cannot understand is, some pulleys don't chatter, while others do. I am an apprentice, and would like to stop the trouble or at least know what causes it. *A.*—Pulleys chatter from a great variety of causes, and you seem to have tried about every plan which might be expected to stop it. Some pulleys are of such proportions as to make them liable to chatter of themselves, no matter what kind of lathe they may be turned in. Your statement as to the amount of wear which has taken place in the teeth of the pinion, would indicate that the lathe is considerably worn all over, and probably not as heavily designed as lathes are now made. We do not think, however, that the pinion has enough teeth in it. It would probably be better if it had not less than 16. This in all probability is a case in which, if there is much pulley turning to do, it would pay to get a tool adapted to such work.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

Gear Wheels. See Adv., page 16.

Link-Belting.

Send for catalogue of Link-Belting.

Over 50,000,000 feet of Link-Belt in use.

Link-Belt Machinery Co., Chicago and N. Y.

Shafting Straighteners. J. H. Wells, Tampa Fla.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

Lamb Knitting Machine Co., Chicopee Falls, Mass.

Machine work and patternmaking. Anderson Machine Works, Peekskill, N. Y.

Light articles built to order by the American Sewing Machine Co., Philadelphia, Pa.

For Electric Recording Steam Gauge, write Telemeter Co., 44 Barclay st., New York.

The Best Upright Hammers run by belt are made by W. P. Duncan & Co., Bellefonte, Pa.

For catalogue of 2d hand lathes, planers, etc., write to John Steptoe & Co., Cincinnati, O.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

Solid Nickel-Seated "Pop" Safety Valves. Consolidated Safety Valve Co., 111 Liberty st., N. Y.

The bulldozer forming, forging and bending machine. Williams, White & Co., Moline, Ill., m'f'rs.

R. Dudgeon, 24 Columbia st., New York. Improved Hydraulic Jacks and Roller Tube Expanders.

Davis Key-Seating Machines, kept in stock, by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

"How to Keep Boilers Clean." A book mailed free, by James E. Hotchkiss, 120 Liberty st., N. Y.

Ice and Refrigerating Machines, 124 built, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.

Selden Packing, for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

Drawing Materials, all kinds. Get catalogue. Mention this paper. G. S. Woolman, 116 Fulton st., N.Y.

Buy the Excel Upright Drill; sizes 20", 25", 28", 32", 36" swing. Currier & Snyder, Worcester, Mass.

The American Engineer, Gaff Building, Chicago, Illinois. Send for sample copy and premium list for 1888.

The Improved Tabor Steam Engine Indicator, made and sold by The Ashcroft Mfg. Co., 111 Liberty st., N. Y.

Engine Lathes, Hand Lathes, and other fine tools. Assortment large; prices low. Frasse & Co., 92 Park row, N. Y.

For the latest improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.

Berryman Patent Feed Water Heater and Purifier, and the Economic Boiler Feed Pump. Benj. F. Kelley, 91 Liberty st., New York.

Ten 16-in. Engine Lathes, ten 18 in. Eng. Lathes, ten 14 in. Eng. Lathes, ten 15 in. Engine Lathes. Nicholson & Waterman, Providence, R. I.

Split Pulleys at low prices and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker st., Philadelphia, Pa.

Quints' Pat. Auto. Steam Engine Governor. Correspondence solicited from mfrs. of Throttle Gov'n Engines. Leonard & McCoy, 118 Liberty st., N. Y.

The Brown & Sharpe Mfg. Co. have placed at No. 23 S. Canal st., Chicago, Ill., a sample line of milling machines and other machinery with S. A. Smith.

Machinists' supplies, brass goods, m'f'rs' supplies, polishing materials, all kinds wire, metals, etc.; in any quantity. Jordan & Gottfried, 208 Canal st., N.Y.

For Best Return Steam Traps, Pressure Regulators, Positive-Acting Pump Govs., Back-Pressure Valves. T. Kieley, 11 W. 13th st., N.Y. Send for des'n.

Curtis Pressure Regulators, Curtis Return Trap, Curtis Damper Regulator. See Dec. 10, p 15. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

The Holly Manufacturing Company, of Lockport, N. Y., will send, on application, their pamphlet, illustrating pumping machinery and reports of duty trials.

$1 for 12 delivered as sample. Brown's machinery wipes do not ignite by spontaneous combustion, and are cheaper and better than waste. Geo. S. Brown, 2290 Washington st., Boston, Mass.

W. H. Hoffman, consulting engineer, 94 Liberty st., N. Y. Mechanical engineering in all its branches; working drawings for the transmission of power by steam, water, air and electricity.

Patents relating to machinery should be secured by experienced mechanics acquainted with the law. Write to A. K. Mansfield & Co., mechanical engineers and patent experts, 280 Broadway, N. Y.

Hot Water Supply. A practical treatise on the fitting of hot-water apparatus for domestic and general purposes. By F. Dye. 82 pages, with 25 illustrations. 12mo., cloth, $1. Send for catalogue. E. & F. N. Spon, 35 Murray st., N. Y

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines, and current practice in testing engines and boilers. Price, $2, postpaid. Published by John Wiley & Sons, 15 Astor Place, New York.

"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers, the full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUB'G CO., 96 Fulton st., New York.

Fraser & Archer, general machinery dealers, have an excellent assortment of 20, 25, 26, 28, 36 and 38 inch upright drills in stock, which they are offering at extremely reasonable prices. It will pay any one in need of drills to communicate with them before making their purchases elsewhere. Any one interested in iron and wood machine tools would be repaid by a visit to inspect the complete line at their warerooms, No. 121 Chambers st., N. Y.

Practical Drawing and Modern Locomotive Construction. By J. G. A. Meyer. The articles on Practical Drawing commenced with Oct. 23 1886 issue, up to and including Dec. 31, 1887 issue. 40 papers have been published. Price, 5c. each. Locomotive Construction commenced with June 27, 1885 issue, up to and including Dec. 24, 1887 issue. 54 papers have appeared. Price, 5c. each. Any or all of the numbers can be supplied. AMERICAN MACHINIST Publishing Company, 96 Fulton street, N. Y.

MANUFACTURES

W. E. Hartman expects to build a machine shop at Bessemer, Ala.

The Newark (Ohio) Wire Cloth Company will rebuild their works at once.

Additions to the plant of the Rutland (Vt.) Electric Light Co., are to be made.

George W. Bonett will build a brass and iron foundry at Paddock's Village, Vt.

The Hampden Foundry and Machine Company has been chartered at Clifton, W. Va.

The Atlantic, Birmingham and Kansas City R. R. Co. expect to build repair shops at Macon, Ga.

The Fairfield Paper Company are building an addition to their paper mill at Salmon Falls, Mass.

The Falls Rivet Company, Cuyahoga Falls, O. io, will rebuild their works, recently destroyed by fire.

The hardware factory of Clayton Bros., Bristol, Vt., recently destroyed by fire, will be rebuilt at once.

Ingraham & O'Neill are building a machine shop at Huntington, W. Va., in place of the one recently burned.

E. S. Hamlin & Co., lumber manufacturers, of Biddeford, Me., contemplate a large addition to their works.

The Dial Engine Works, to manufacture steam engine and boilers, has been incorporated at Columbia, S. C.

The Claremont (N. H.) Electric Light Company has been organized at Claremont, N. H. Charles H. Clark is secretary.

The Dallas Electric Light, Water and Manufacturing Company has been chartered at Dallas, Tex., by L. Craddock and others.

Doyle & Co. will build a machine shop and foundry at Huntington, W. Va., and also contemplate building one at Cannelton, W. Va.

The New Haven Box and Nail Company has leased the Pembroke Iron Works, at Pembroke, Me., and will put in machinery for making wire nails.

The Davidson Motor Company has been organized at Nashville, Tenn., to manufacture engines and other machinery. O. E. Davidson is one of the interested parties.

C. W. Woodford, of Keeseville, N. Y., will build a horse nail factory at Kokomo, Ind. He will put machinery in an old building and begin manufacture this winter, and build new works in the spring.

The Hampden Watch Company will move from Springfield, Mass., to Canton, Ohio, in the spring. They are building shops at the last named place. They employ 500 hands, many of whom will go to Canton with the company.

Christian Devries, Charles Marshall, James C. Gittings, Fielder I. Hiss and Nelson Hiss have incorporated the P. Hanson Hiss Manufacturing Company, capital stock, $30,000, to manufacture and sell furniture.—*Manufacturers' Gazette* (Baltimore).

New water-works, or the enlargement of existing works are contemplated at Moorestown, N. J.; Oxford, N. C.; Kentland, Ind.; Dover, N. H.; Hillsboro, Ill.; Grafton, W. Va.; Dayton, Ky.; Sheldon, Ill.; West Branch, Mich.; Fernandina, Fla.; Sandwich, Mass.

Pedrick & Ayer, Philadelphia, Pa., have bought a lot 40 x 160 feet near their present works, and intend in the near future to build a new two-story shop. They have lately put in a Belden steam hammer, a Currier & Snyder 36 inch drill, and have attached a Pratt & Whitney turret head to one of their lathes. They have also built one of their own heavy milling machines for use in their shop.

Montgomery & Co., 105 Fulton street, New York, have issued a large catalogue, fully illustrated, of tools, supplies, and machinery for all branches of the mechanical trades. The catalogue contains many hundred engravings of tools for machinists engineers, factories, mills, jewelers, silversmiths, die sinkers, engravers, watchmakers, watch case makers, model makers, gunsmiths, locksmiths, and all other metal workers. They will send this catalogue on receipt of 14 cents, in stamps if more convenient.

Harvey Scribner's machine shop, Gardiner (Me.), is full of orders that will keep it busy some time. Among others he has an order for a stave machine for lime casks, a birch machine for making bedsteads, and a heading and shingle machine. Another order is for a shingle machine for the Webster mills at Orono. A new branch of work is the manufacture of band-saws, for which Mr. Scribner now has three orders. He has been manufacturing these saws but three months and has sold six already. —*Industrial Journal.*

The Steelton (Pa.) *Reporter*, of the 10th inst., says of the Pennsylvania Steel Works at that place: "An experimental mill will be erected in the near future. The mill will be built on the same style as the new billet mill, and will be 75 feet square. The castings made from open-hearth steel will likely be made in the new building. Work on the new billet mill is progressing satisfactorily and will be ready to start early in the new year. Additional machinery will be added to the rail mill as soon as time can be spared to close the mill."

The Bulletin says: A new iron-ore field is likely to be developed on the eastern shore of Maryland. There is a large body of bog ore in this section, much of which analyzes above 50 per cent. of metallic iron, and all of which is low in phosphorus and sulphur. "It will melt like cheese," so we are told. The Choptank Iron Ore Mining Company, a Philadelphia organization, has obtained control of a large body of this ore in Caroline county, within easy reach of present railroad facilities, and proposes to at once place the ore on the market. The deposit is about one hundred miles from Philadelphia.

The Betts Machine Company, Wilmington, Delaware, shipped last month to Solid Steel Company, Alliance, Ohio, a heavy 62" lathe, with shears 27½ feet long, and a few days ago sent to Chicago a planer to plane 6 ft. x 6 ft. x 20 ft., with three tools on it. They have now in the works for shipment this month, another large planer for the Holly Manufacturing Company, of Southport, N. Y., to plane 8 feet square by 16 feet long, with four tools, and have orders on their books for another of those massive steel geared 66" lathes for the Midvale Steel Company, Philadelphia, as well as a variety of other tools.

It is extremely likely that the Laclede Rolling Mills (St. Louis, Mo.) will be reopened to business by a co-operative company, under a lease tendered by its owners, and accepted conditionally already. Mr. Lewis, who has been the superintendent at the mills for several years, is at the head of the co-operative movement, which embraces the workmen under him, private parties, and a considerable number of iron houses and manufacturers heretofore handling or using the mill's products to greater or less extent. For obvious reasons the projectors of the new enterprise do not wish to unfold their plans to the public until the subscriptions are completed and the restarting of the works is definitely determined upon as to date and other details. But it transpires that the workmen agree to the retention of one-third of their wages by the co-operative officers, as an earnest of their intention to serve faithfully, without strikes, the new interest—presumably to be used in the payment of the shares to be issued to them as stockholders. A good many of the mills' manufacturing consumers in the city have been solicited to take stock, and have generally done so, in amounts ranging from $1,000 upwards. We learn that the subscriptions are very nearly completed.—*The Age of Steel.*

November sales of the Babcock & Wilcox boilers are as follows: Bibb Mfg. Co., Macon, Ga., 208 horse-power; Corporation of the Cathedral of the Incarnation, Garden City, L. I., 104 horse-power; Georgia Lunatic Asylum, Milledgeville, Ga., 136 horse-power; W. E. Cameron, Manchester, England, 30 horse-power; Anthero Arenjo, Lisbon, Spain, 15 horse-power; Louis Glorieux, Roubaix, France, 166 horse-power; Hammond & Co., London, for Spain, 104 horse-power; Arthur Butler, for Mootcharri, Tirhoot, India, 40 horse-power; Arthur Butler, for Mootcharri, Tirhoot, India, 45 horse-power; L. Fontaine, La Madeleine les Lille, France, 138 horse-power; George Richard & Co., L'd, Broadheath, near Manchester, England, 122 horse-power; W. Clark & Sons, Liverpool, England, 3d order, 126 horse-power; Harding Croker, Lille, France, 30 horse-power; Walker Bros., London, for Ceylon, 5th order, 25 horse-power; M. Kennedy, Greymouth, New Zealand, 248 horse-power; J. & J. Boyd, Shettleston, Eng., 2nd order, 104 horse-power; Louis Carrie, Marseilles, France, 51 horse-power; Cadogan Electric Light Co., London, England, 208 horse-power; Edison Electric Illuminating Co., of New York (for 39th street station), 3d order, 803 horse-power; A. Gillibert & Co., Marseilles, France, 220 horse-power; Bay State Sugar Refinery, Boston, Mass., 3rd order, 960 horse-power; Cowles Syndicate Co., L'd, Milton, near Stoke on Trent, England, 280 horse-power. Making a total of over 4,000 horse-power for the month.

Machinists' Supplies and Iron.

New York, Dec. 22, 1887.

Iron—American Pig—No material change has taken place in the condition of trade since the close of last week. Supplies are being steadily absorbed by deliveries on contracts. There is little new business in progress, and recent purchases are only to cover current wants. There is still a scarcity of Standard Lehigh brands for prompt or near delivery, which enables prices to to be maintained. We quote Standard Lehigh brands firm at $21 to $21.50 for No. 1 X Foundry, but outside brands are obtainable at $20 to $20.50. No. 2 X is quoted $19 to $19.50 for Standard brands, but others can be had at $18 to $18.50, and Grey Forge ranges from $16 to $17.

Scotch Pig—Business has been almost at a stand here, consumers being unwilling to pay the higher prices asked. We quote Coltness, $22 to $22.25; Glengarnock, $19.75 to $20.25; Gartsherrie, $21 to $21.50; Summerlee, $21.25 to $21.50; Eglinton, $19 to $19.25; Langloan, $20 to $20.50; Dalmellington, $20 to $20.50, and Clyde, $20 to $20.50.

Lead—There seems to be more of a disposition to sell, and in consequence of this trade has developed an easier tendency. Transactions have taken place at 5c. for spot, 5.05c. for January, 5.10 for February, and 5⅛c. for March.

✻WANTED✻

"Situation and Help" Advertisements only inserted under this head. Rate, 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

Wanted—Men to sell planes, see page 11.

Wanted—By a practical die-cutter and toolmaker, situation; used to taking charge of help. Address W. W. O., Am. Machinist.

Wanted—Situation as foreman boilermaker by a man of experience on all kinds of boiler work; good references; age 35. Eclipse, Am. Machinist.

A skillful and accurate tool maker wants a situation where first class workmanship is required; is active and energetic. Energy, Am. Machinist.

Mechanical engineer and designer, competent as supt., head draftsman, or engineer, desires to change; Corliss engine expert. Indicator, Am. Machinist.

Wanted - Superior salesmen, understanding steam enginery; apparatus expensive; entire time; commission only. Give references and experience. G. N. D., Am. Machinist.

A young technical graduate wants work under a skillful man; has experience in drawing room; is a practical machinist; good mech'l ability; intelligent and steady. Address H., 357 Court st., B'klyn, N. Y.

Wanted—Situation by first-class practical eng'eer; exp. covers marine, stationary, and pumping engines compound, high and low pressure; familiar with indicator; good draughtsman. J. M., Am. Machinist.

Wanted—A foreman for a foundry job shop; about 40 moulders employed. Address, stating age, references and salary expected, Foundry, Box 3143, Boston, Mass.

Wanted—Working foreman to take charge of iron foundry employing from six to ten men; principal work marine and stationary engine castings. Iron Foundry, Am. Machinist.

Wanted—In the West, foreman, bright and competent in controlling men and assembling small turret and fox lathe work, etc, rapidly. Address B. R., care Am. Machinist, giving age, detailed experience, reference, etc.

✝ MISCELLANEOUS WANTS. ✝

Advertisements will be inserted under this head at 35 cents per line, each insertion.

Crescent solid lubricant, clean, durable, cheap, prevents hot boxes. Crescent Mfg. Co., Cleveland.

The Crescent automatic grease cup is adapted to every service. Crescent Mfg. Co., Cleveland, Ohio.

Wanted- Parties having machinery specialties to build, to correspond with. Box 75, Am. Machinist.

I want to buy some specialty patents or manufacture on royalty; give description or patent. Address F. D. Cummer, Cleveland, Ohio.

Wanted—A practical mechanic with $5,000 to $15,000 as partner in a foundry and machine shop, or will sell whole interest on easy terms. John C. Kilner, York, Neb.

A. C. Christensen, 26 Church st., N. Y., mech. and hydraulic engineer, late chf. draftsman at H. R. Worthington. Designs and working drawings of water-works, pumps, gen. mach. and pat. drawings.

Engine and boiler for sale; an 80 horse-power Buckeye automatic engine and 120 horse-power boiler with heater, exhaust injector, damper regulator, piping, etc., in excellent order. Will be sold at a great bargain. Address P. O., Box 40, Troy, N. Y.

For Sale—39″ x 12′, 24 ′ x 16′, 18″ x 9′ screw cutting lathes; Daniels wood planer, 20″ x 18′; Hotchkiss belt power hammer, ram 100 pounds, air cylinder, 4″ x 16″; all second-hand, in good order. J. & G. Rich, 120 N. 6th st., Phila., Pa.

If you are troubled with scale in your boiler, whether from lime, sulphur, iron, salt or other mineral or corrosive water, send for circular of Petroleum Resolvent, adopted on one hundred railroads. Contains neither alkali or acid, and costs but ten cents a week for the largest locomotive boiler. Pittsburgh Boiler Scale Resolvent Co. Pittsburgh, Pa.

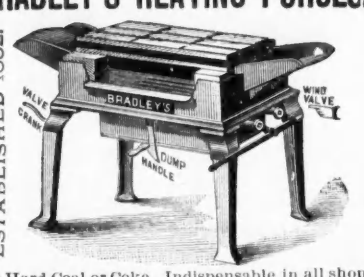
BRADLEY'S UPRIGHT CUSHIONED HELVE HAMMER

Established 1832.

Combines all the best elements essential in a first-class Hammer. Has more good points, does more and better work and costs less for repairs than any other **Hammer** in the **World.**

BRADLEY'S HEATING FORGES.

ESTABLISHED 1832.



For Hard Coal or Coke. Indispensable in all shops to keep **Bradley's Cushioned Hammers** and men fully employed and reduces cost of production.

BRADLEY & CO. Syracuse. N.Y.

STEPHENS PATENT VISES

ONE-HALF TIME and LABOR saved by using this solid, strong, durable, firm-hold, quick-working Lever (Not Screw) Vise. Has improved Taper-Pipe and other attachments. Sold by the trade. Send for circular

TOWER & LYON,
95 Chambers Street, New York.
Successors to Melvin Stephens.

For Sale—A Great Bargain.

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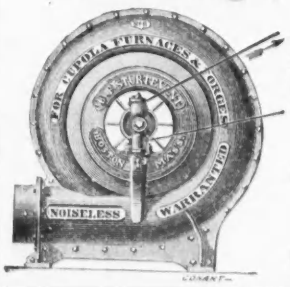

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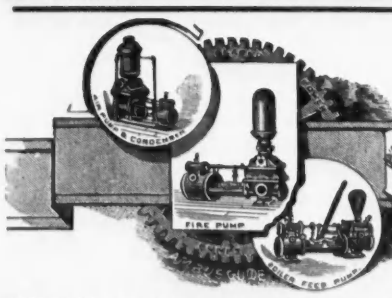

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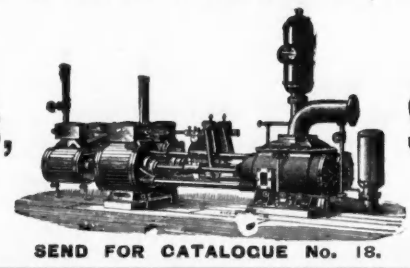

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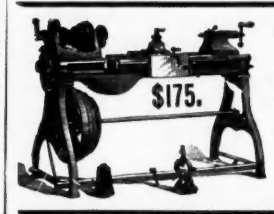

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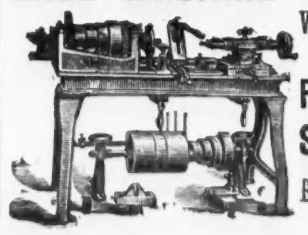

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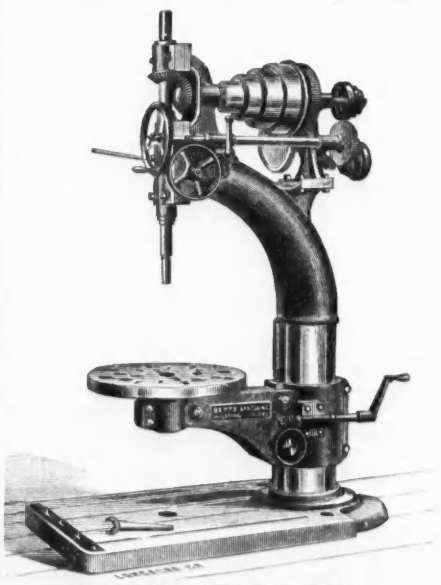

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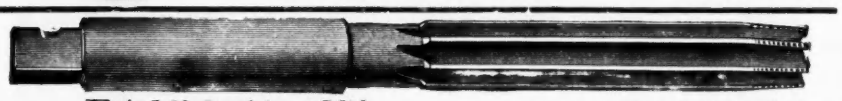

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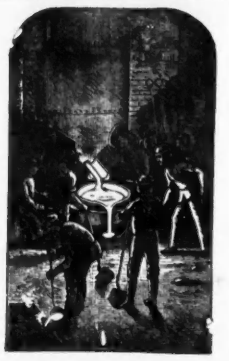

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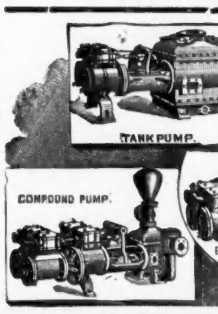

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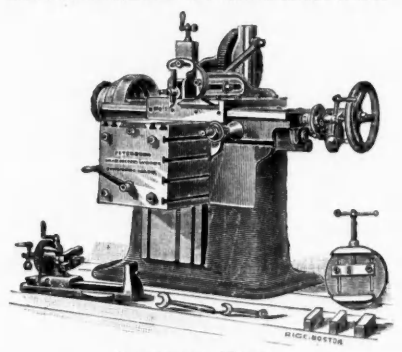

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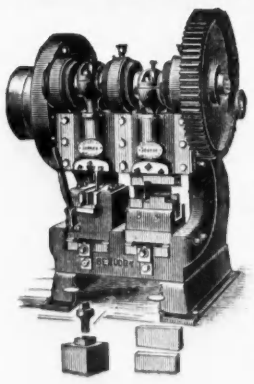

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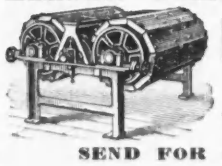

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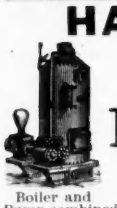
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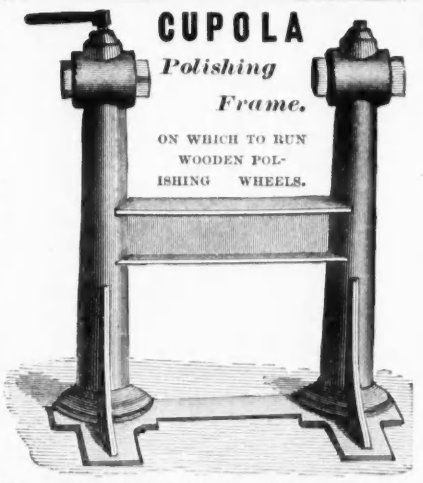

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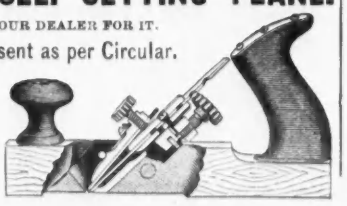

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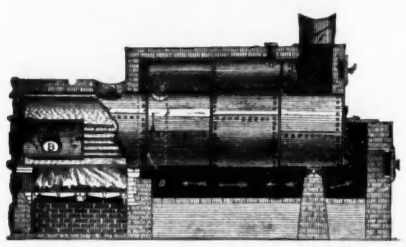

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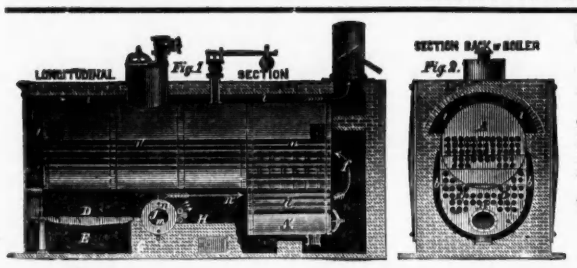

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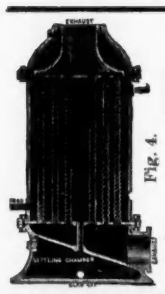

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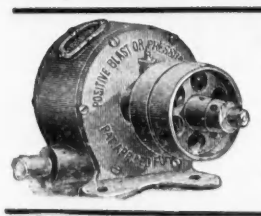

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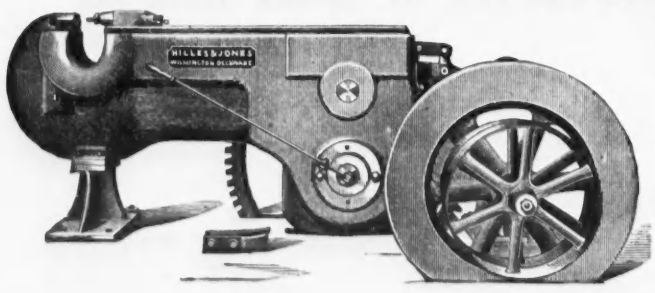

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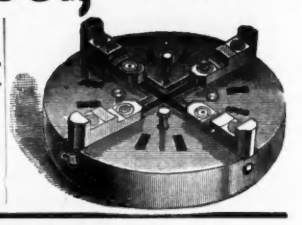

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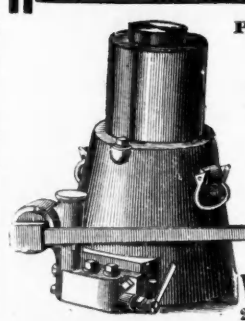

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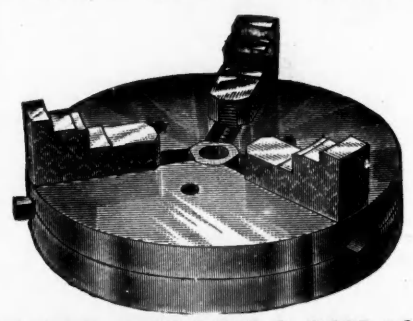

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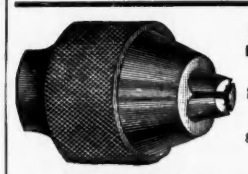

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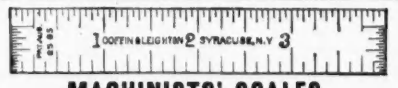

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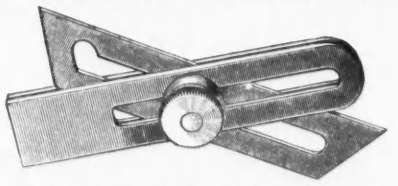

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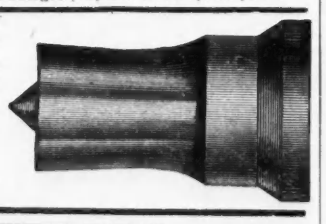

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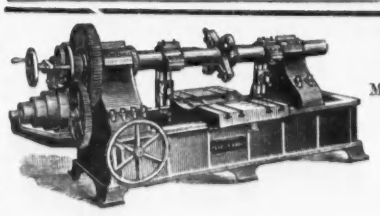

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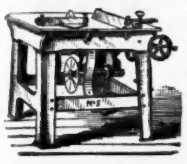

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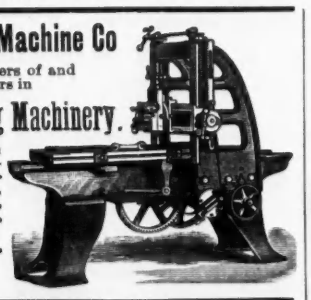

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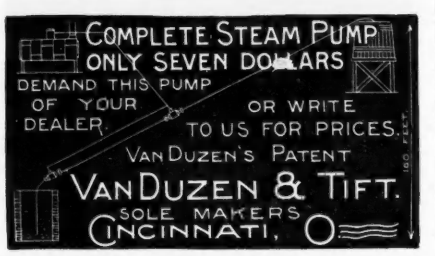

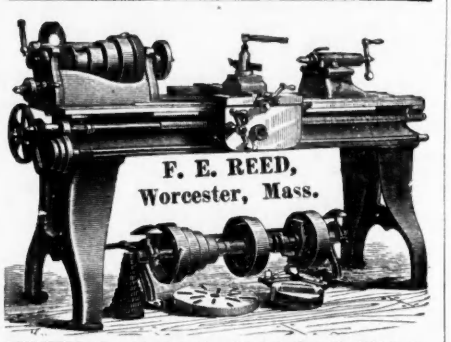

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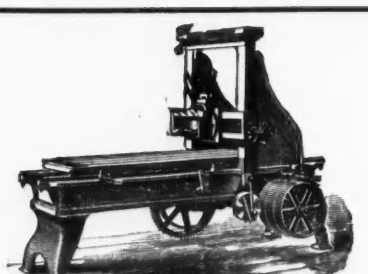

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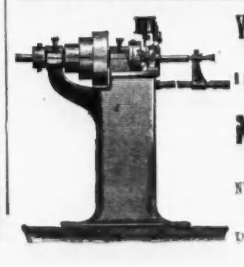

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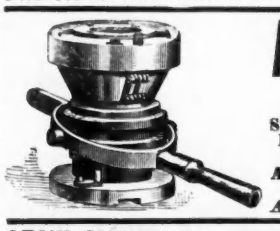

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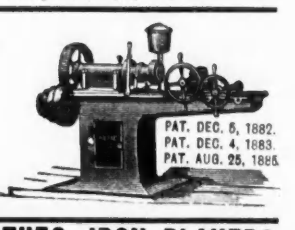

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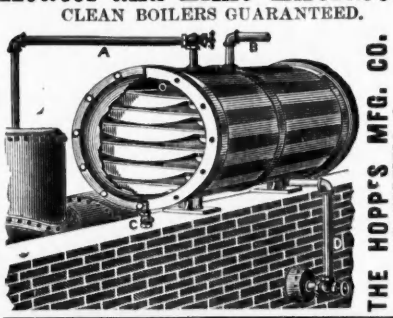

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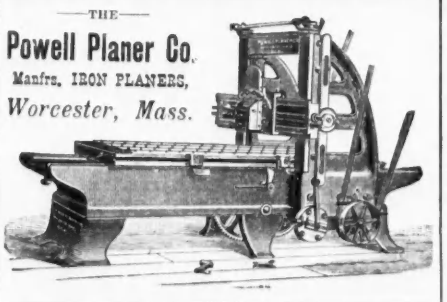

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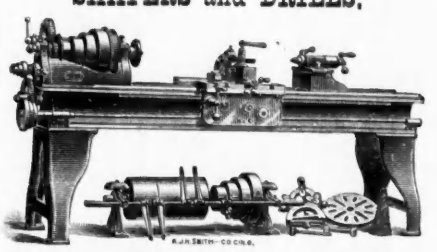

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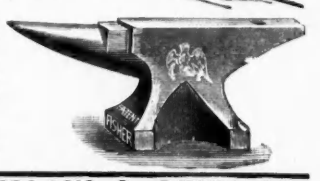

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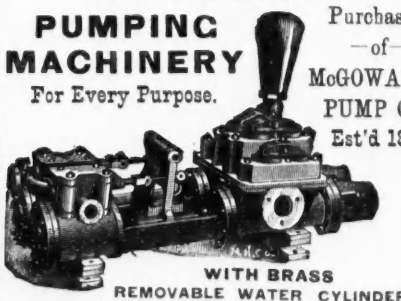

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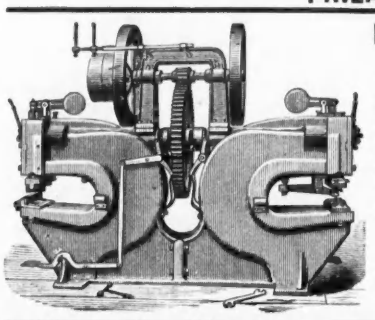

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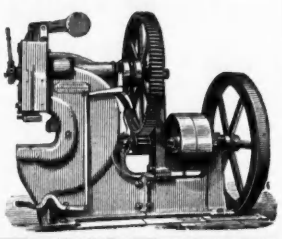

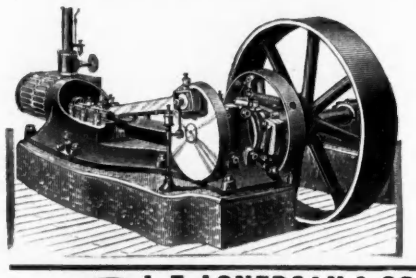

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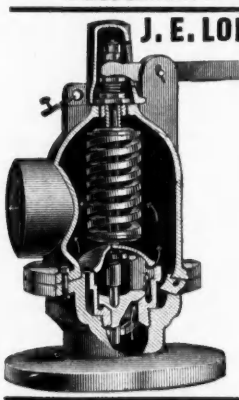

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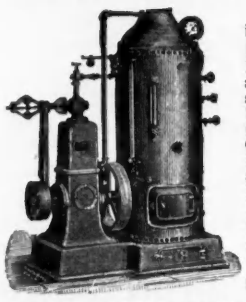

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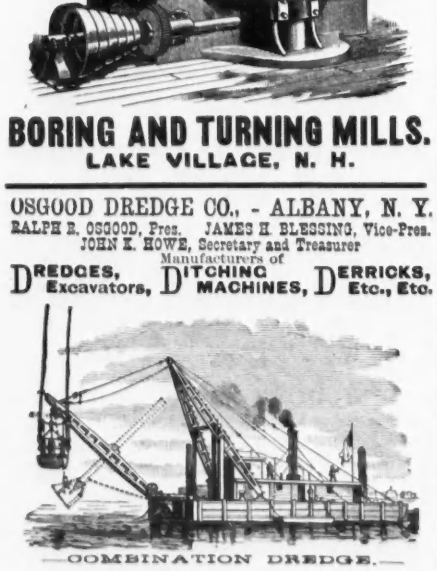

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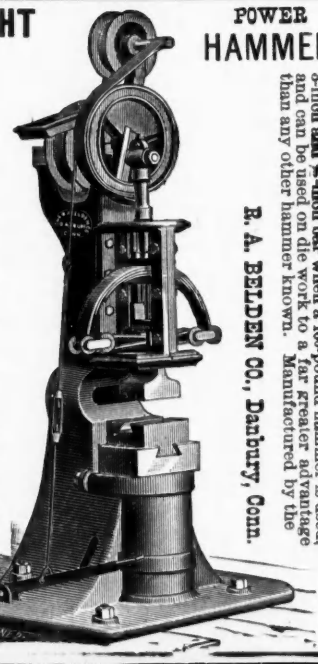

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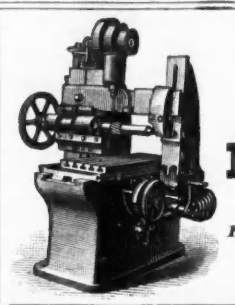

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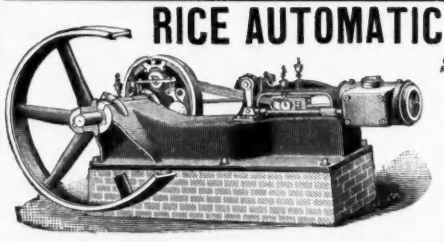

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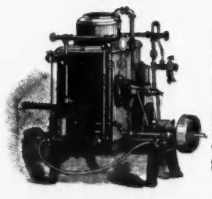

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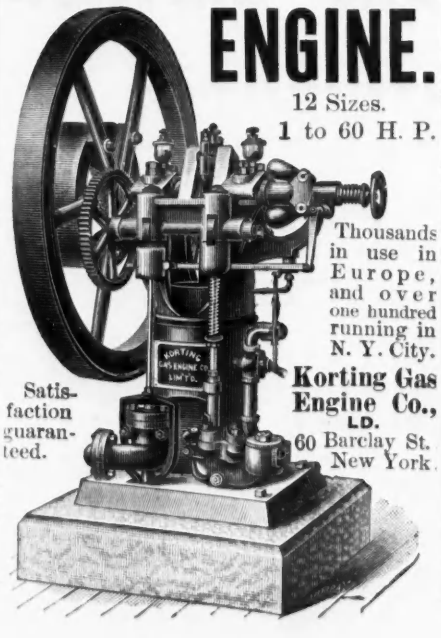

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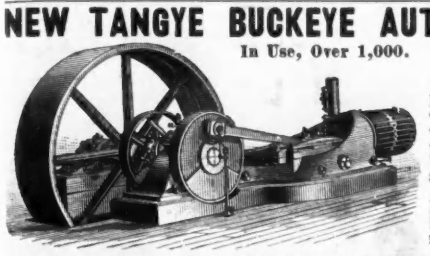

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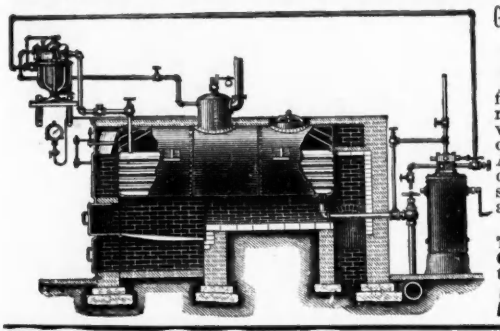

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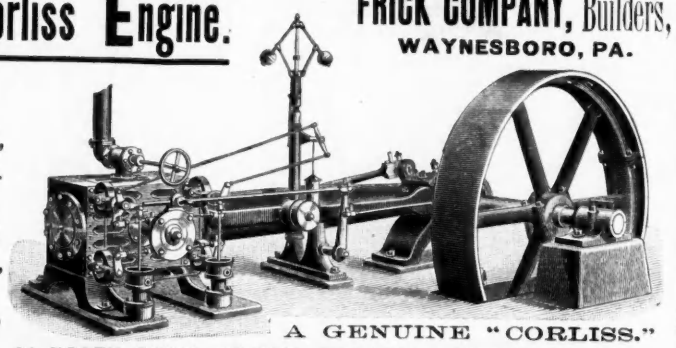

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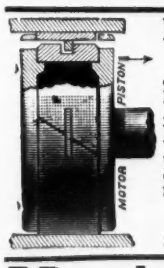

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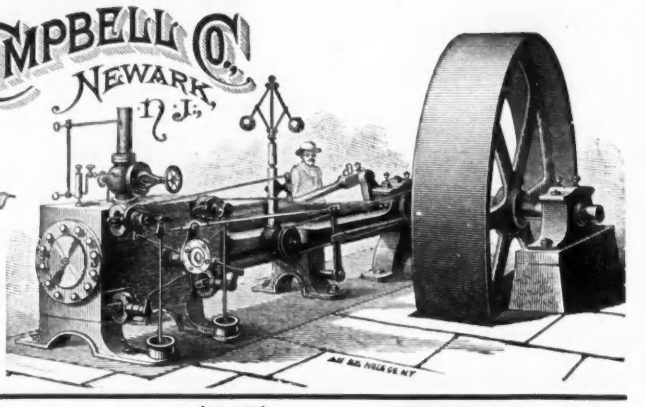

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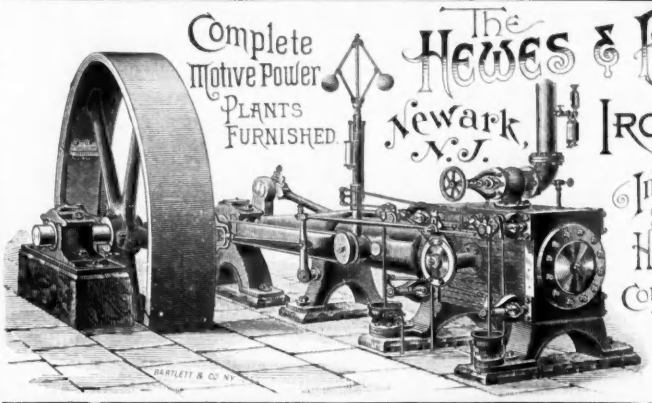

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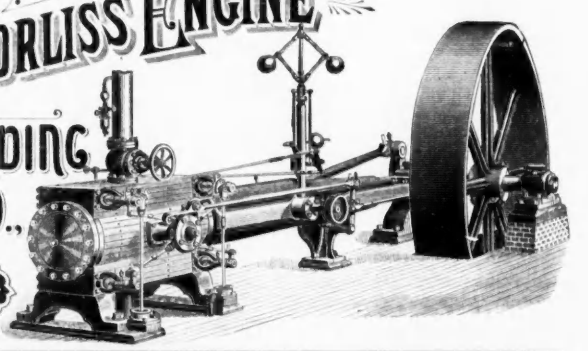

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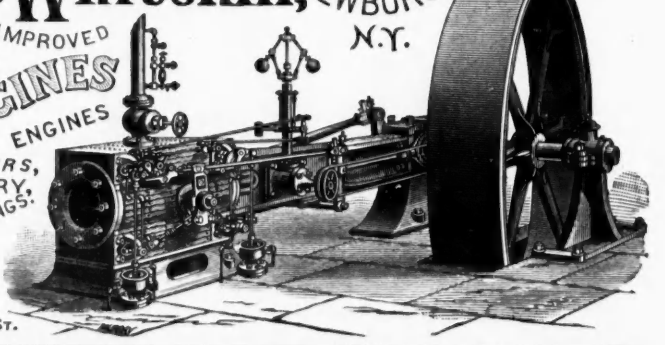

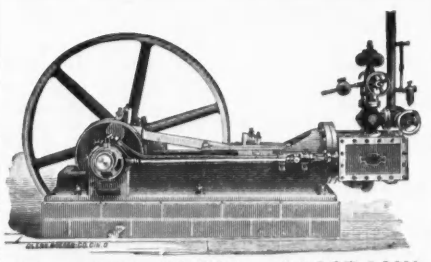

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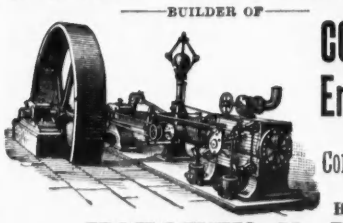

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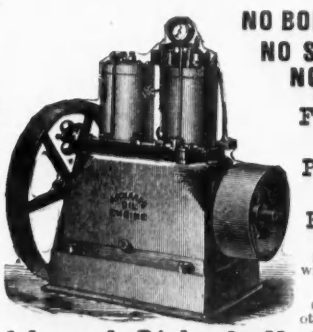

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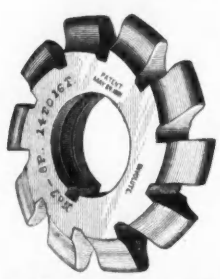

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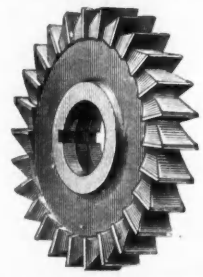

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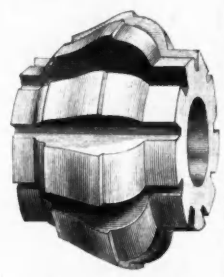

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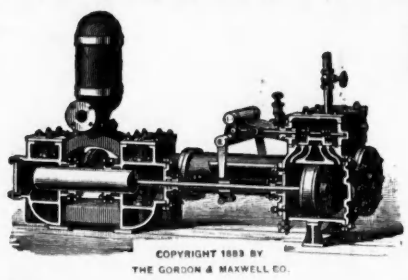

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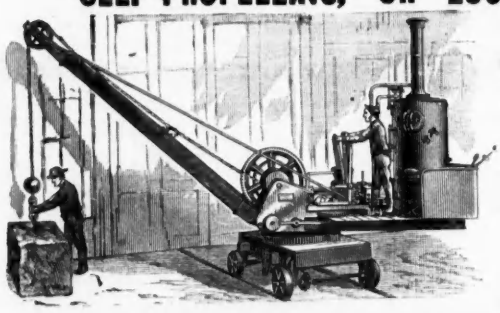

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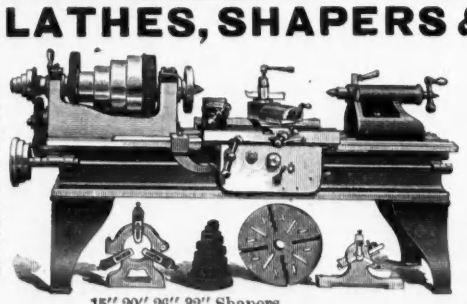

15" 20" 26" 32" Shapers.
17" 19" 21" 24" 27" Engine Lathes.
20" 24" Upright Drills.
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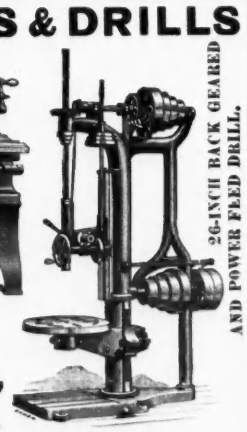

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(See "Important" Notice of Engine Lathes on page 15.)

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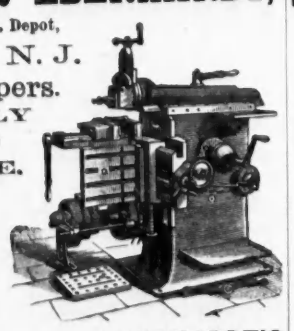

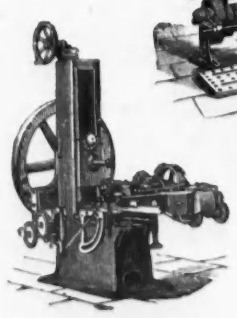

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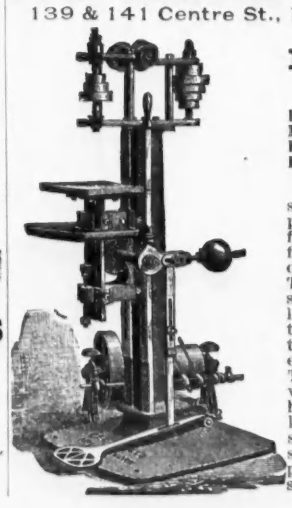

The machine shown in cut is especially designed for jobbing, and is fitted up with one or two spindles. Those with two spindles have pulley, with two sections, which gives two speeds to each spindle. Those fitted up with one spindle have a cone pulley with three sizes. The back shaft has a cone pulley with four sizes.

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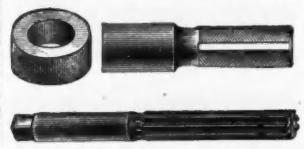

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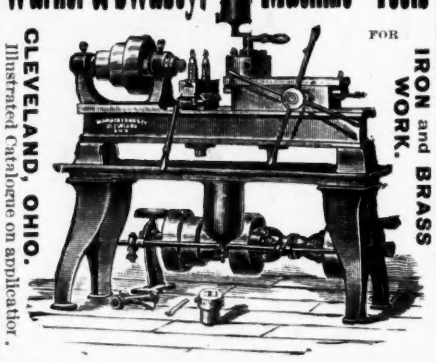

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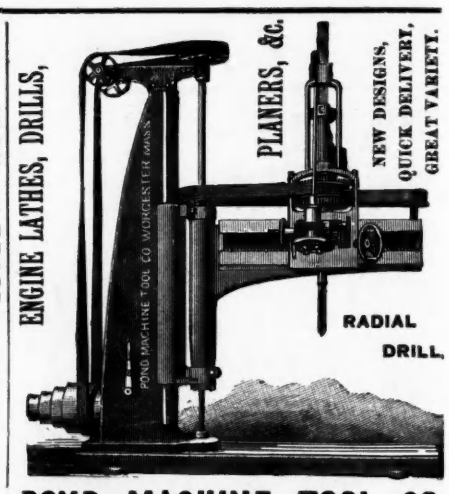

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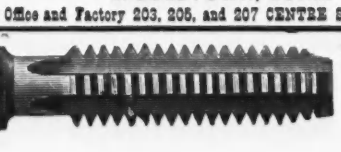

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